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See article by CLOSNER and PORAT on PRESTRESSED-CONCRETE TANKS for JET-FUEL DEPOT

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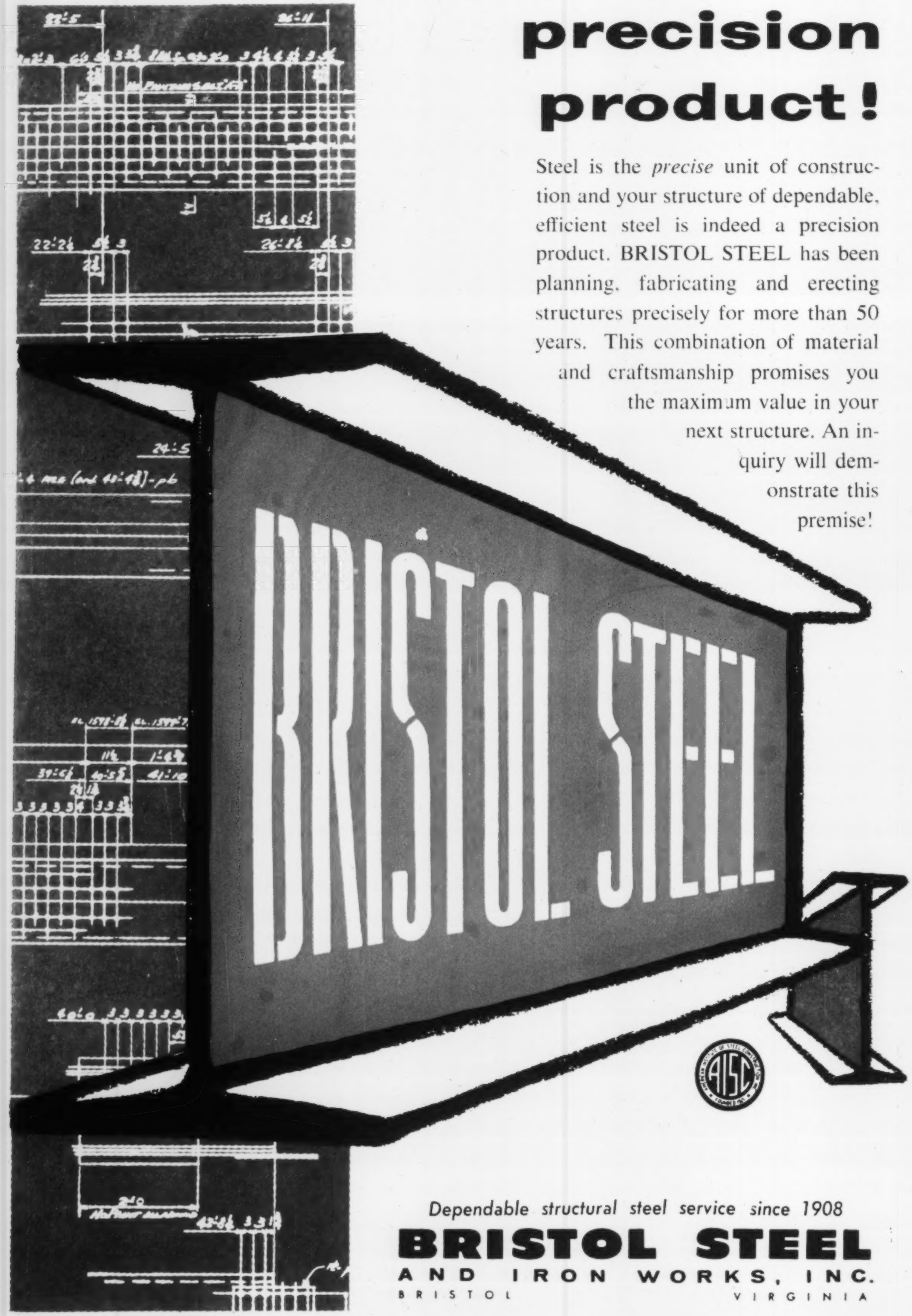

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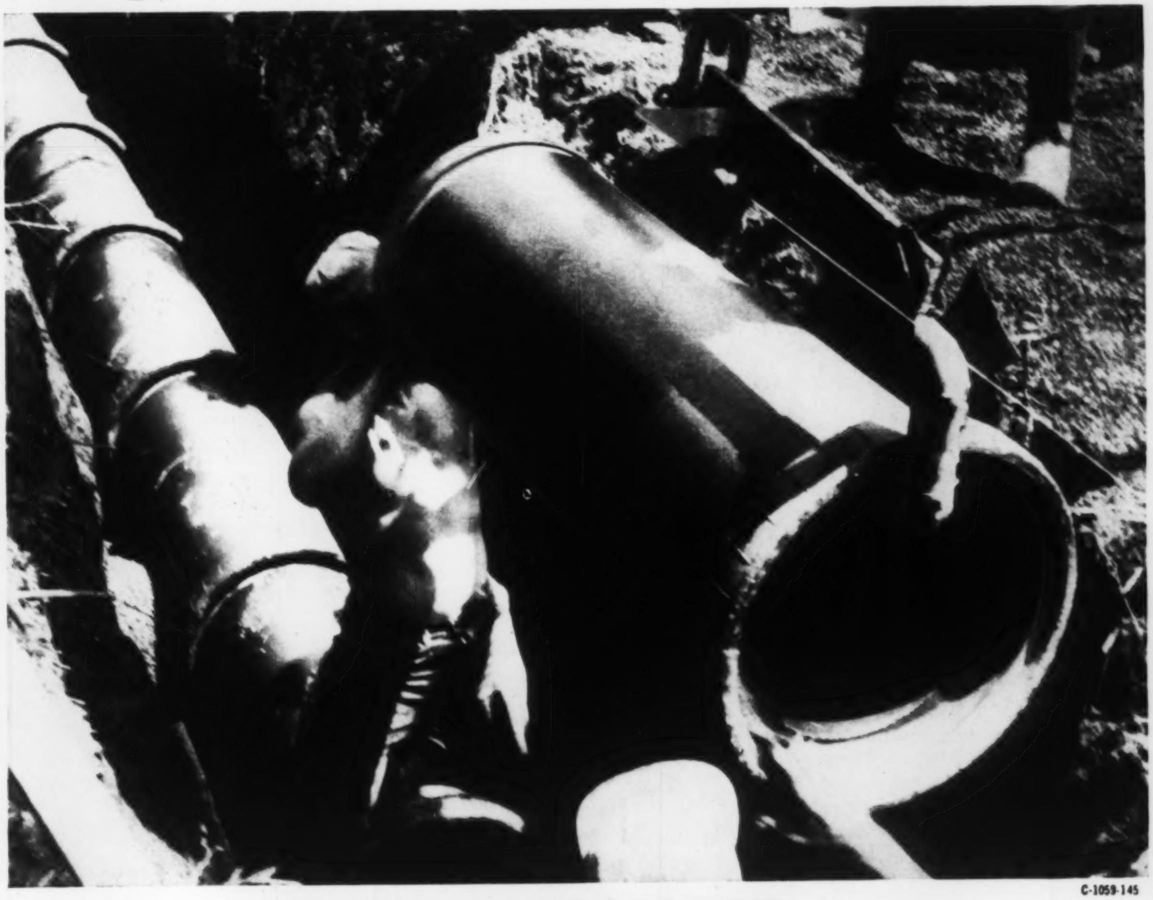

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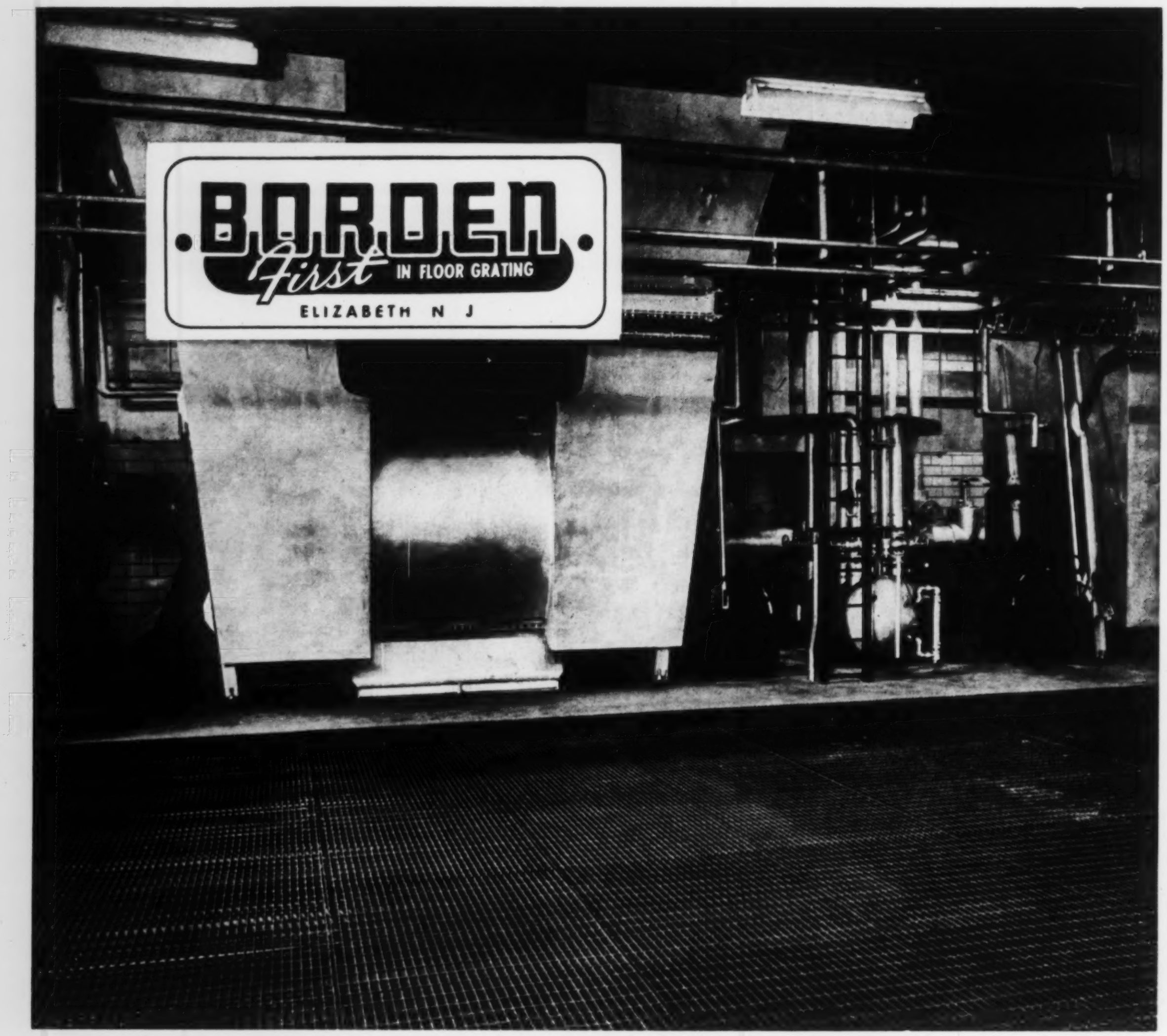

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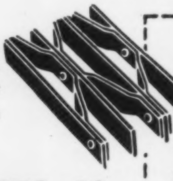

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CIVIL ENGINEERING

APRIL 1960
VOL. 30 • NO. 4

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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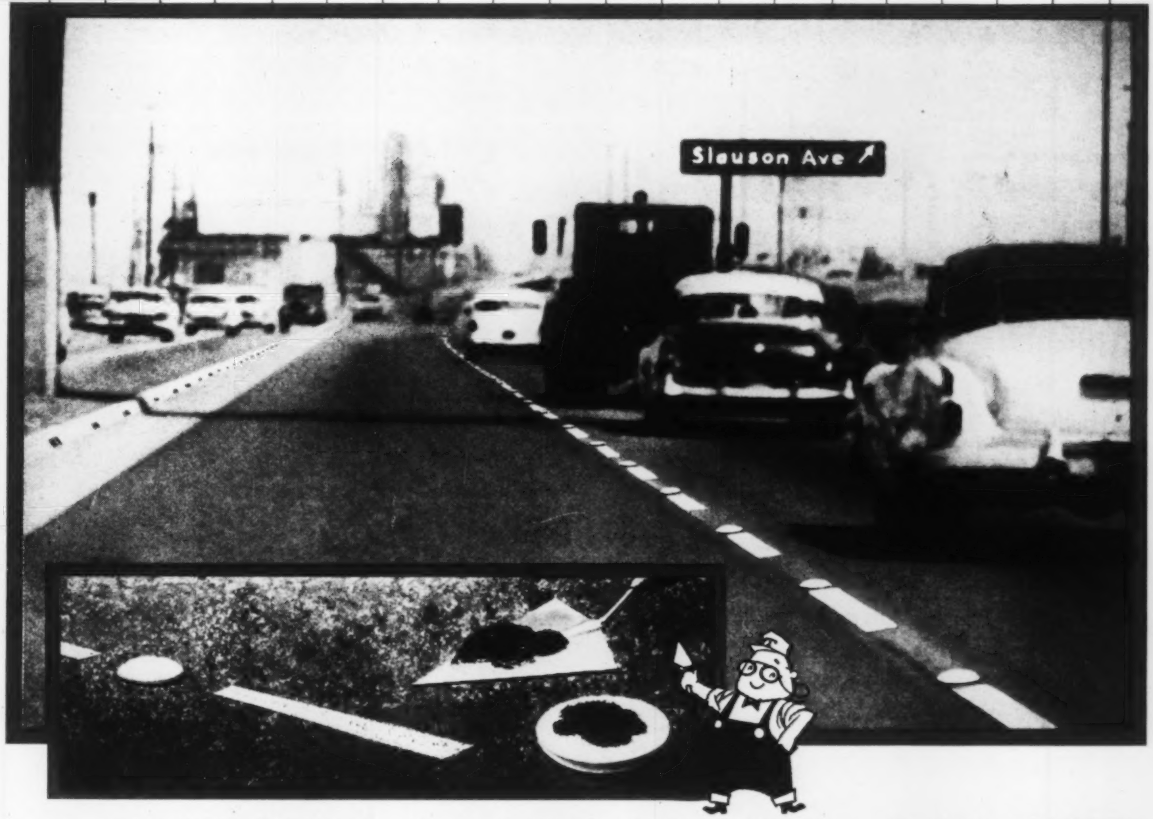

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The California State Highway Department discovered it . . . adhesives based on THIOKOL polysulfide liquid polymer produces a concrete-to-concrete bond *that's stronger than concrete itself.*

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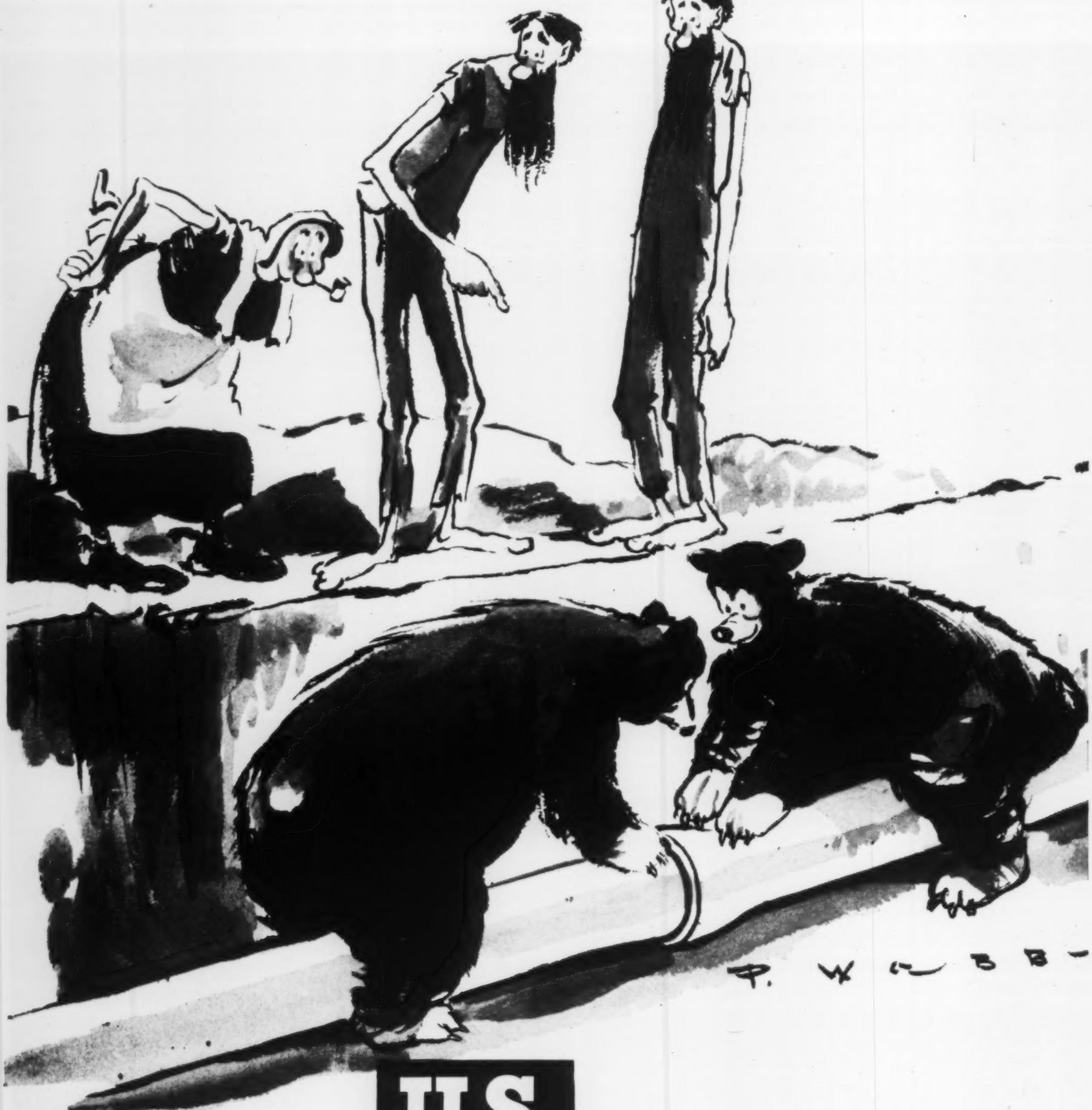

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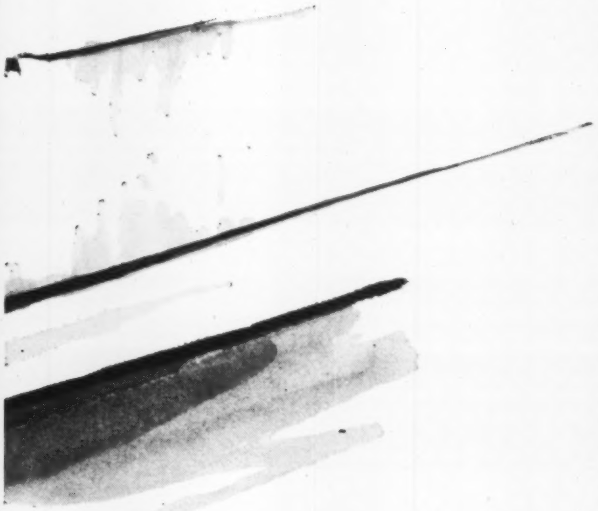
everybody's doin' it

Laying Tyton Joint® pipe, that is. This easy-to-assemble pipe is so foolproof even a bear can get in the act. Only one accessory needed—a simple rubber gasket. No bell holes. No caulking equipment. No nuts or bolts to fiddle with. No weather worries, either. Tyton doesn't mind wet feet . . . can be laid in rain or wet trench. Result: more working days, more lengths laid per man hour, lower installation cost. Sound interesting? It is! Call or write for the facts.



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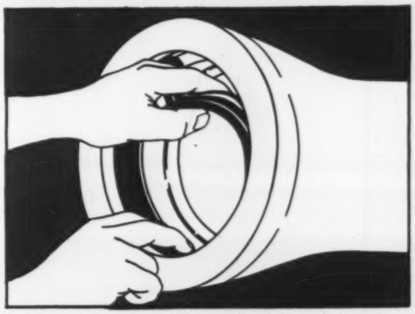
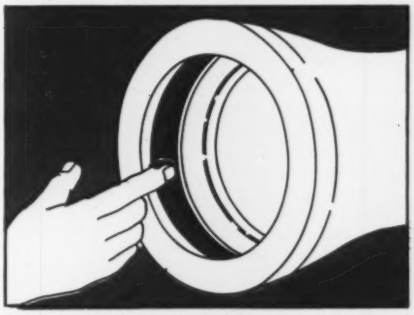
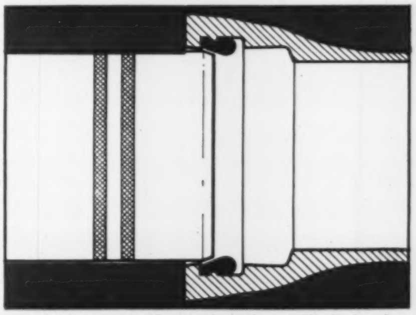


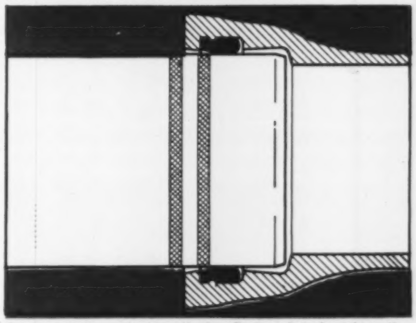
Insert gasket with groove over bead in gasket seat . . . a simple hand operation.



Wipe film of Tyton Joint® lubricant over inside of gasket. Your receiving pipe is ready.



Insert plain end of entering pipe until it touches gasket. Note two painted stripes on end.



Push entering pipe until the first painted stripe disappears and the second stripe is approximately flush with bell face. The joint is sealed . . . bottle-tight, permanently! The job's done . . . . fast, efficiently, economically. Could anything be simpler?

A new bridge for tall ships

Freighters have no trouble clearing the new, high-level Summit Bridge over the Chesapeake and Delaware Canal. This 2,058′ cantilever bridge provides a 135′ vertical clearance over the channel, and carries a four-lane highway linking Delaware with Maryland. The new bridge replaces an old vertical-lift highway bridge that was located about a half-mile west. ☐ The structure was designed for the District Engineer, U. S. Army Engineering District, Philadelphia, by the J. E. Greiner Company, Consulting Engineers, Baltimore, Maryland. American Bridge handled fabrication and erection. Amount of steel used: 5,545 tons. ☐ The Summit Bridge has a total of nine spans, including three main spans of 300′, 600′ and 300′. Write for information on our construction services, or call our contracting office nearest you.

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PIPE THAT DOESN'T GET COLD FEET IN WET TRENCHES

This cast iron pipe was installed to carry water to an important industrial site in Indiana.

At the time of installation, weather conditions were severe; the trenches were wet and muddy.

Still, the cast iron pipe was easily and speedily assembled, enabling the contractor to complete the job well ahead of the deadline.

Cast iron pipe does not get cold feet over rugged soil conditions. Its rugged design, corrosion-resistant qualities, and bottle-tight joints will withstand the most severe pressures.

Modern, cement-lined cast iron pipe will deliver a continued full flow of water for at least a century . . . and rarely requires repairs or replacement.

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Problem: How to Microfilm Old Drawings So They Can Be Read

Microfilming is widely used for recording and storing the mountains of drawings and data individual companies must maintain. But to anyone who works with microfilmed drawings, they know the condition of the original is very critical in order to obtain a readable microfilm print. Faint lines, weak lettering and dimension markings, creases, and dirt smudges become impossible handicaps when the originals are first reduced 16 to 29 times and then enlarged for reading or reproduction. Today's advanced drafting techniques avoid this problem in new drawings, but what about a company's old drawings? Few are ever suitable for microfilming without extensive, meticulous restorative work. Yet, something must be done with these old drawings if the microfilm file is to be complete and useful.

Dietzgen answers this problem with a number of products and techniques developed for restoring old drawings preparatory to microfilming. The Dietzgen "wash-off" process is preferred by many because no darkroom work is involved. Corrections are easily made on the "wash-off" media eliminating the tedious retouching of a photographic negative. Backgrounds come clean with a wipe of a brush or sponge so that even the finest line stands out sharp and clear.

Dietzgen's "wash-off" process puts new life into old drawings quickly and inexpensively.

Today thousands of old drawings which appeared hopeless subjects for microfilming have been salvaged by Dietzgen products and techniques . . . and it's this experience which can prove invaluable to you if old drawings have handcuffed your company's microfilm program.

JETS, MISSILES AND DIAZOS

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Four companies coating diazo papers were given the problem. Two immediately said it was impossible. The third submitted a specially coated stock which provided the speed but not the print quality required.

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When installing this highway safety feature, contractors specify ATLAS WHITE DURAPLASTIC air-entraining portland cement in the mortar mix. The uniform whiteness of this cement produces a concrete that has the necessary reflectivity. Because it is air-entraining, this cement produces a more durable concrete that resists exposure to freezing-thawing weather and the application of de-icing salts. For literature, write: Universal Atlas Cement, 100 Park Ave., New York 17, N. Y.

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...ON A MILE-LONG BRIDGE BUILT BY YUBA

With plans well underway on major bridges at Buffalo, N.Y. and Knoxville, Tenn., Yuba Erectors recently started construction on another: the erection of sub- and super-structures of the high-level Martinez-Benicia Bridge across upper San Francisco Bay.

Four lanes wide, 6215 feet long, and with a maximum height of 138 feet, this $14.3 million structure is scheduled for completion in 1962.

To complete the bridge on schedule and in record time, a habit with this fast-moving nationwide organization, Yuba Erectors will make full use of experience and skills gained in building such other notable structures as the Richmond-San Rafael and Glen Canyon bridges.

On these and other major projects, Yuba has developed advanced technologies and introduced specialized land and water equipment and procedures that solve scores of problems and expedite construction.

Bridge erection is but one phase of Yuba Erectors' operations. As a member of Yuba's diversified family, this division is backed by Yuba's fabricating plants—East and West—and can thus provide a wide range of services for all Yuba divisions in the heavy structural and mechanical fields. Call on Yuba, when you have a project in either field—wherever it may be located.

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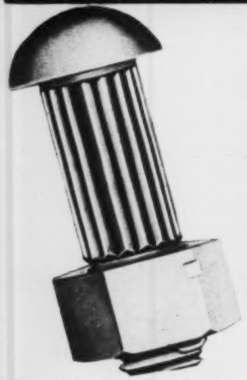

Constructed With 13,400 ANCO Structural Rib Bolts And ANCO Lock Nuts

Like so many of today's giant TV Towers, the new record-breaker erected for WGAN-TV, Portland, Maine, was constructed with ANCO Structural Rib Bolts and Lock Nuts.

Careful designers are specifying ANCO Structural Rib Bolts and Lock Nuts for all types of towers—for radio, television, high tension power transmission lines, micro-wave, radar antennas and reflectors, and many others. They offer the advantages of maximum speed, strength and safety.

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*WGAN-TV Tower—World's tallest structure, 154 feet taller than the Empire State Building * Designed to withstand winds up to 150 miles per hour * Contains longest vertical lift elevator ever constructed * Guy cables: 4½ miles total length * Weight of tower steel: 520,000 pounds * Weight of antenna: 28,000 pounds * Designed, fabricated and erected by Kline Iron and Steel Company, Columbia, South Carolina.*

At Idlewild International Airport

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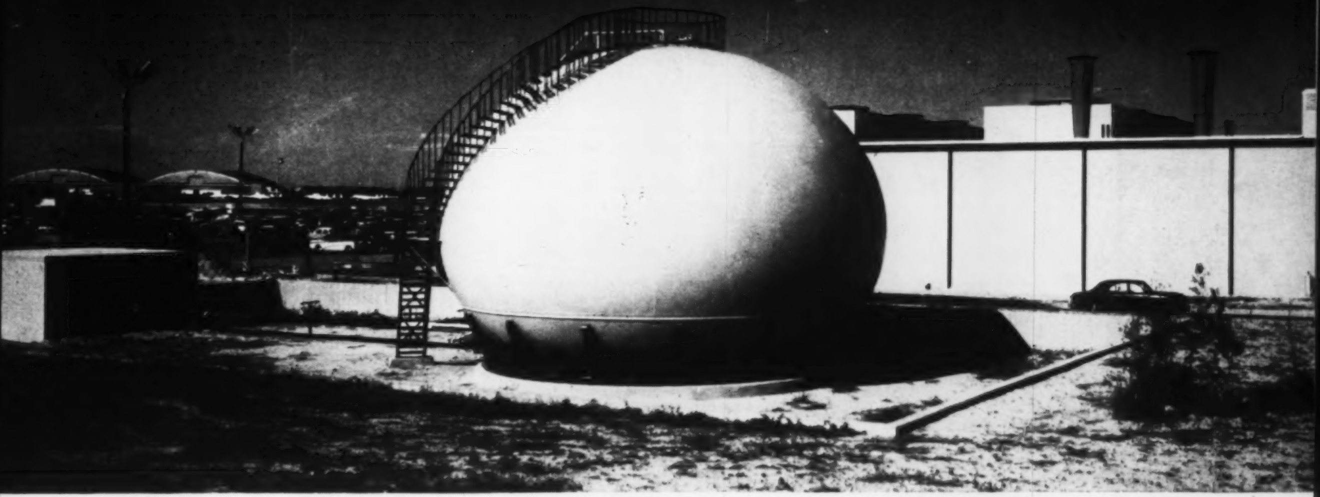
stores fuel for $6,000,000 heating system



CB&I Structure complements beauty and efficiency of new facilities

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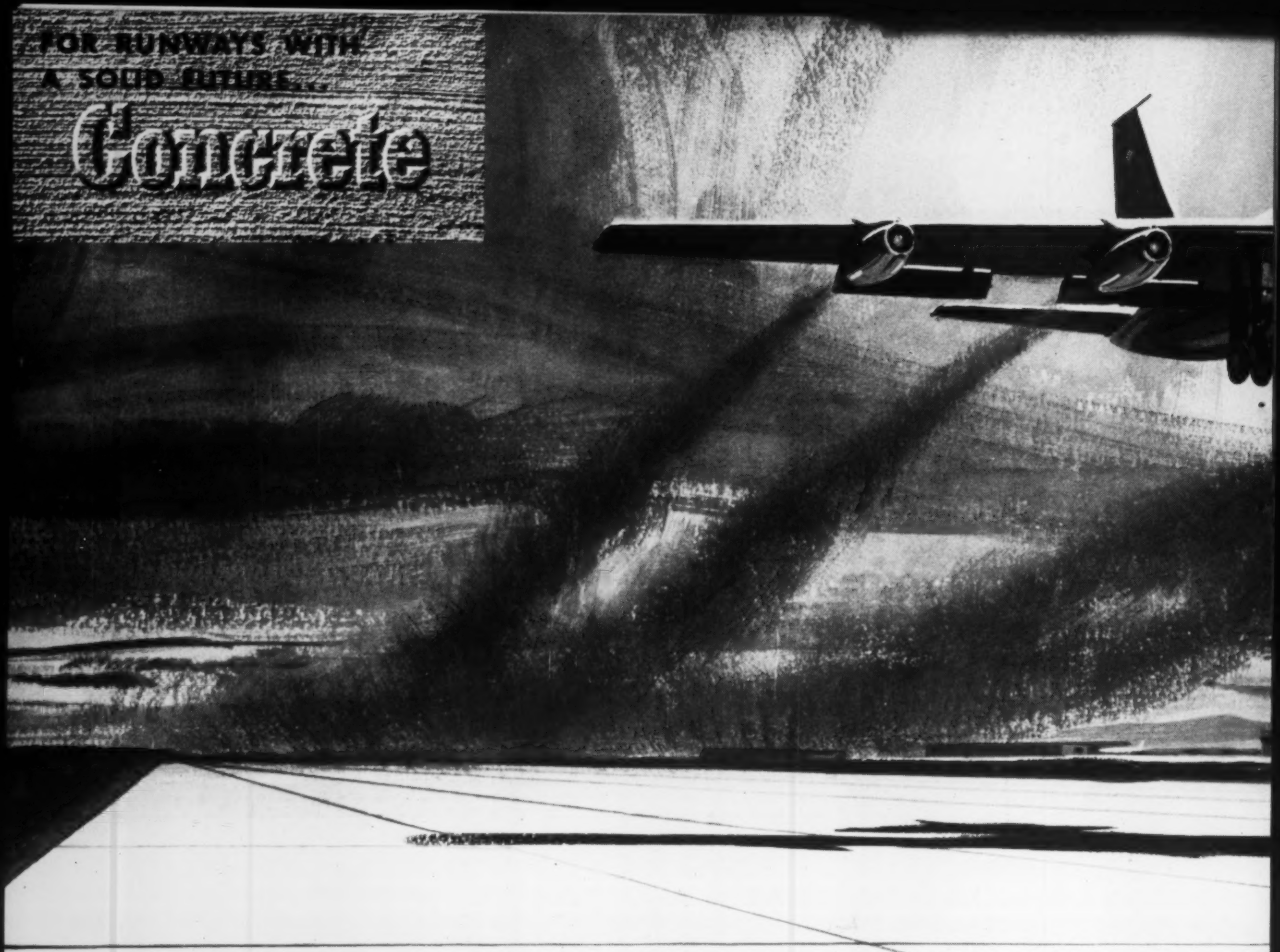


At Los Angeles International Airport, old runway resurfaced with

Los Angeles gets ready for jets

Above. Artist's sketch shows how airport will look with modern concrete runways and new futuristic-styled terminal area.

Right. Photo shows modern equipment now placing new concrete directly on the old flexible pavement of runway 25L. They're paving 1,600 feet of 25-ft. strips every working day, will take just 120 days for the whole runway—6,150 feet long by 150 feet wide!

CONCRETE makes

150-ton jets feel right at home!

A 12-inch overlay of concrete provides needed strength to handle the heaviest jet wheel loads ever expected. Concrete is the only true jet-age pavement. On runways *built specifically for jets* concrete has been the overwhelming choice.

And in reconstruction, where the old flexible pavement can still serve as a subbase, covering it with minimum-thickness concrete gives big savings.

Such overlays are possible because concrete is *not flexible*. The strength is in the concrete itself—and not in built-up, layer construction. Concrete is more than a *smoothing* overlay. It's the one pavement with beam strength that enables engineers to compute loads mathematically, design runways for an expected life of *50 years and longer!*

And hot jet blasts can't melt concrete or chew it up. Spilled fuels do no damage, either. Light-colored concrete with its natural grainy surface is the high safety pavement, too. You get better visibility at night and dependable skid resistance whatever the weather.

These are all good reasons, too, why concrete is the preferred pavement for heavy-duty highways—such as those being built for the new Interstate System.

PORTLAND CEMENT ASSOCIATION *A national organization to improve and extend the uses of concrete*

New Construction Idea News

How COMMERCIAL Ribs Support All Five

U. S. BUREAU OF RECLAMATION PHOTO FROM UPI

COLORADO RIVER DISAPPEARS as flow is diverted through tunnel in west canyon wall where dam will soon start to rise in the 700 ft. gorge of the Colorado River. Glen Canyon Dam is a $325,000,000 Bureau of Reclamation project including a 900,000 kw hydroelectric power plant. It will create an upstream reservoir 186 miles long to infuse vigor and productivity into arid wasteland.

CROWN 21
CROWN 23

WIDEST BORE EVER SUPPORTED with steel required heaviest tunnel ribs ever bent in quantity. Portals of spillway tunnels are 113 ft. wide, over 80 ft. high at crown. Bore gradually changes to circular 63 ft. diameter. COMMERCIAL engineered and produced all ribs...design involved solving of ever-changing curves...fabrication included multi-curvature bending of 14" WF beams @ 167#/ft. for roof support at transition and 12" WF beams @ 72#/ft. for circular section. Solved was one of the most difficult tunnel support jobs ever undertaken.

Glen Canyon Tunnels

Glen Canyon Dam — Merritt-Chapman & Scott Corp., Prime Contractor
Access Tunnel — Frazier-Davis Construction Co., and Gibson-Roberts Construction Co., Tunnel Contractors
Left Spillway Tunnel—Frazier-Davis Construction Co., Tunnel Contractor
Right Spillway Tunnel — Northwood, Inc., Tunnel Contractor
Left Diversion Tunnel—Frazier-Davis Construction Co., Tunnel Contractor
Right Diversion Tunnel—Mountain States Construction Co., Prime Contractor

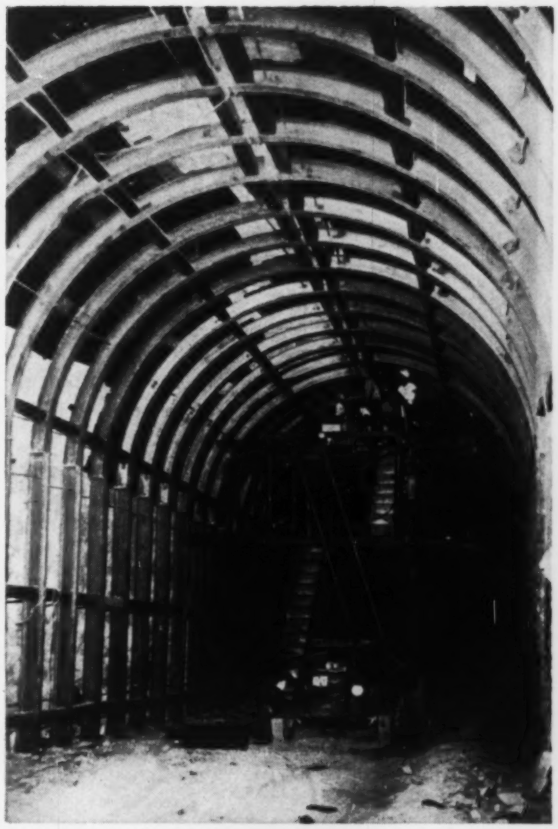
COMMERCIAL steel ribs and posts—unanimous choice of the four tunnel contractors—provide support for access, diversion and spillway tunnels for Glen Canyon Dam project... scheduled completion 1964.

Working with the Bureau of Reclamation, COMMERCIAL designed and fabricated steel sets which proved to be the solution for supporting these rock tunnels. All were of unusual size, length and roof profile and were constructed under difficult working conditions.

In general: Working conditions in all five tunnels demanded that complete support units be accurately fabricated for easy, fast field erection. The two diversion tunnels, two spillway tunnels and the access tunnel totaled close to 17,000 ft. of tunnel. Delivery schedules were timed to tie in with job progress target dates in the tunnel headings.

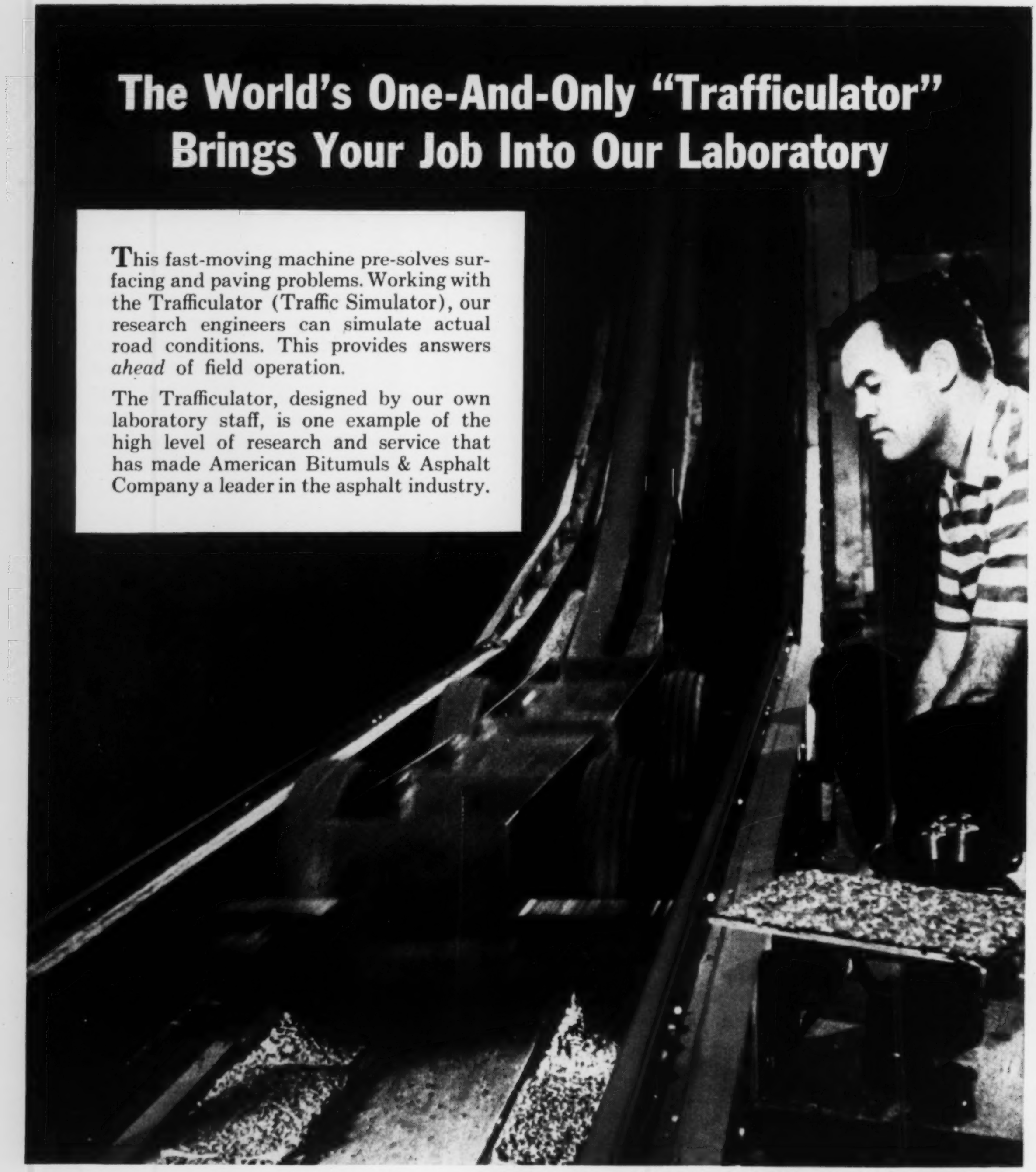
In particular: COMMERCIAL solved the extremely difficult task of supporting the multi-profiled transition sections of the spillway tunnels. The problem of size was complicated by the changing elevation and shape of the transitions. At the portal the section was the rectangle of the open cut surmounted by the arch of the tunnel roof. This shape varied continuously toward the smaller and circular cross section of the tunnel to which the transition joins. In addition, the elevation of the roof, spring and flow lines was ever-changing throughout this section and each line's elevation was different. COMMERCIAL had to design supports to fit three exponential curves — each a different formula.

Complete details of COMMERCIAL's contribution in supporting the spillway tunnels for this U. S. Bureau of Reclamation project are available to you. If you have a challenge involving support for a shaft, surface or sub-surface tunnel—hard or soft ground—engineering counsel, based on more than 30 years of experience, is yours for the asking. Address: Commercial Shearing & Stamping Company, Dept. C-14, Youngstown 1, Ohio.



11,000 FT.—8% GRADE ROADWAY—all in tunnel in the canyon wall with tunnel windows every 1,000 ft.—leads to base of dam and will provide access to future powerhouse. Bore: over 20 ft. wide, 22½ ft. high arched roof. Supports: 4-piece rib and post sets, 8" WF beams @ 31#/ft. set on 4 ft. centers.

TWO DIVERSION TUNNELS each over half mile long, aided by cofferdams, sidetrack the Colorado to allow dam construction. Downstream sections later will be joined with plunging spillway tunnels to handle flash flood overflow. Arch: 21' 10" above and 43' 2" wide at spring line. Finished concrete lining: 41' diameter. Steel supports: 6-piece sets spaced on 4 ft. centers. Ribs and posts: 10" WF @ 45#/ft. supported on double 8" I @ 18.4#/ft. wall beams.



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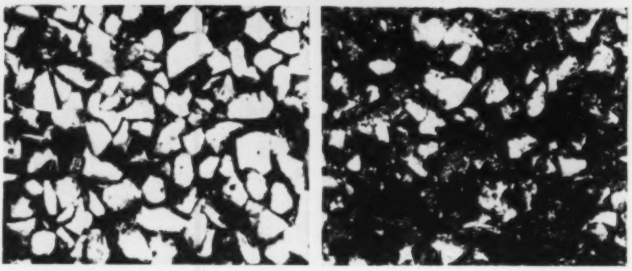
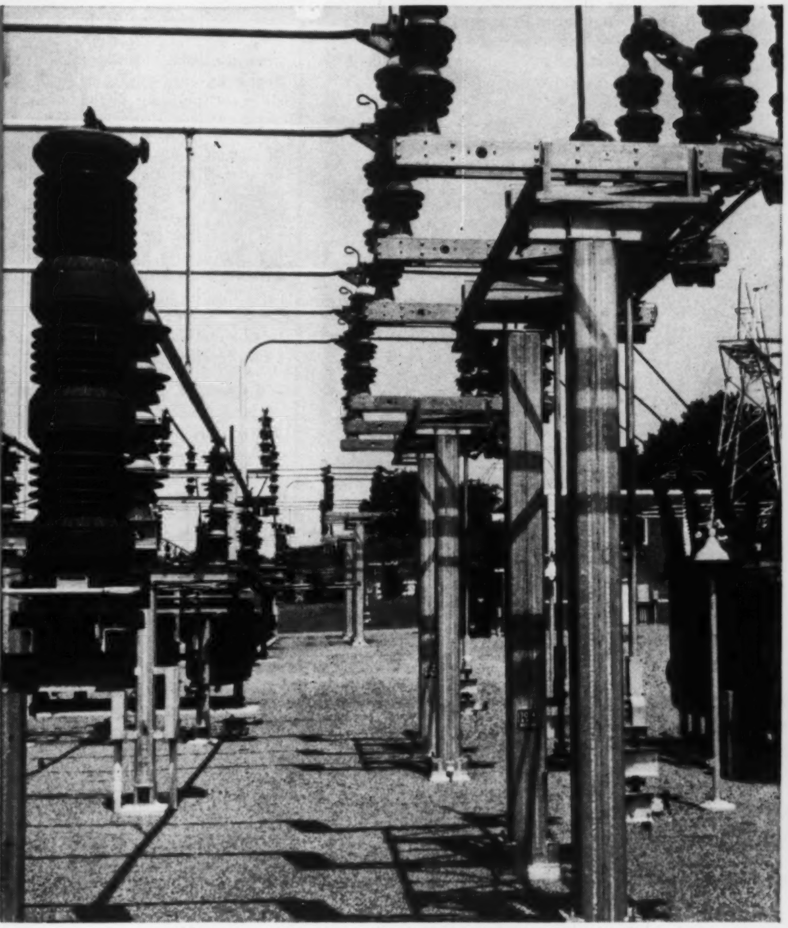


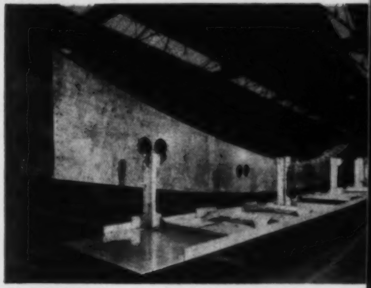
After 1,000 passes by the Trafficulator, cover stone retention on the Cationic panel (left) is 70% better (by weight) than on the panel prepared with regular grade emulsion.

796' aluminum parapet for Fort Pitt Bridge, Pittsburgh, Pa.



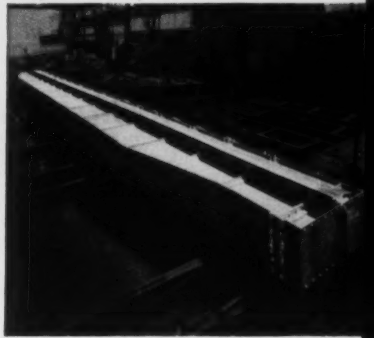
188 structures for various electric substations, totalling 141,000 lbs of aluminum.

Aluminum traffic lane markers, Walt Whitman Bridge, Phila.



Shop fabrication of aluminum traffic lane markers.

Multiple-truss demountable aluminum bridge for military use.



86'6" aluminum girder for emergency dam. 22,000 lbs.

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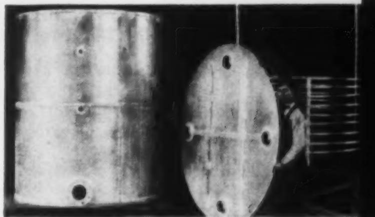

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Aluminum flat bottom storage tank, capacity 40,000 gals.

NEWS OF MEMBERS

Harold G. Arthur recently returned from a six-week stay in Chile where he assisted the Chilean Government in designing Diguillin Dam under an assignment arranged through the International Cooperation Administration. For 24 years he has been in federal service, 16 of them with the Bureau of Reclamation's Denver office.

Robert B. Brooks is one of twelve Washington University graduates receiving alumni federation citations at recent Founders Day ceremonies held on the St. Louis campus. In addition to maintaining an active consulting practice, Mr. Brooks has helped improve public cleansing methods, planned highways, and helped originate the Pan-American Highway. He is a former Vice President of ASCE for Zone III.

Alfred L. Parme has been named head of the Portland Cement Association's newly formed Advanced Engineering Group. Mr. Parme was winner of Cornell University's Fuertes Graduate Medal in 1953 for his work on a concrete shell roof design manual and of ASCE's Moisseiff Medal this past year. He has been with Portland Cement since 1940. Replacing Mr. Parme as manager of the Structural and Railways Bureau of the Association is **Walter E. Kunze,** whose former position as manager of personnel training is being filled by **John C. Seeger, Jr.,** until recently a sanitary engineer in the Association's Conservation Bureau.

Bruno Thurlimann, for the past seven years research professor of civil engineering at Lehigh University, has been named professor of structural engineering at the Swiss Federal Institute of Technology in Zurich. He made the first design—at the Fritz Laboratory at Lehigh—of a complete testing installation in the United States for static and fatigue loading of specimens, components and entire structures and recently completed research work on welded plate girders that makes it possible to write new design procedures for such girders with substantial economies to the public.

Robert J. Mosborg, associate professor of civil engineering at the University of Illinois, has received a 15-month grant from the National Science Foundation under its science faculty fellowship program. Starting in September, Professor Mosborg plans to work on a doctor's degree in civil engineering at the Massachusetts Institute of Technology.

Walter J. Austin, since 1946 a member of the civil engineering staff at the University of Illinois, and currently associate professor of civil engineering there, has accepted appointment as professor of civil engineering at Rice Institute, starting September 1. Holder of the Society's Moisseiff Award for a paper on lateral buckling of elastically end-restrained I-beams, he is now a member of the Structural Division's Task Committee on Compression Members.

Lester D. Lee, president of the firm of Hitchcock & Estabrook, Minneapolis, Minn., announces the firm's expansion and entrance into the electronics consulting engineering field. The firm, which dates back to 1920, has had responsibility for some 500 major projects including power plants, bridges, water treatment plants, industrial buildings, paving, airports, and specialized reports and studies for industry and government.

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TINIUS OLSEN TESTING MACHINE CO.

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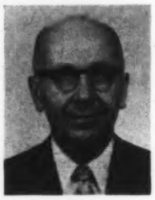
Clarence Rawhouser has accepted an appointment with the United Nations Technical Assistance Operations as hydroelectric engineer in Ceylon. His work will relate principally to the efforts of the Government of Ceylon to develop hydroelectric and multiple-purpose projects on several of the country's major rivers. Prior to his retirement last year, after 30 years of continuous service to the U. S. Government, Mr. Rawhouser spent seven years on an assignment in India for the International Cooperation Administration. During this time he was closely associated with the Bhakra Dam Design Directorate in the design and construction of the 740-ft high dam.



James J. Mennis will supervise sales and installation of Raymond International, Inc.'s line of prestressed products as its new southeast area manager with offices in New Orleans. Before joining Raymond, he was general manager of Prestress, Inc., Albany, N. Y.; president of Prestressing, Inc., San Antonio, Tex.; manager of the Lift Slab Division of the Long Construction Company; and general manager of the Prestressed Concrete Corporation, Kansas City, Mo.

James J. Morgan, for the past four years instructor in civil engineering at the University of Illinois, is one of 61 persons receiving a 1960 Danforth Teacher Study Grant. Mr. Morgan, who will be ready for the final year of study for a doctor of philosophy degree in sanitary engineering, will spend the year beginning September 1, 1960, at the University of Illinois.

Leonard S. Wegman and his partner, **Herbert Mandelbaum,** have moved the Leonard S. Wegman Company to new offices at 235 East 45th Street, New York 17, N. Y.

Don Berdan, formerly with the John B. Dodds engineering firm in Bellevue, Wash., has been appointed city engineer of Kirkland, Wash. Mr. Berdan is a 1955 graduate of the University of Washington.

Albert G. Skelton retired on March 1 as division engineer for the Oregon State Highway Department in Portland after 40 years of highway service. In 1936 he was assigned to Portland where he filled the position of district maintenance engineer until 1947 when he was promoted to his present position. Mr. Skelton is a much-decorated Marine Corps veteran and was retired in 1957 as a brigadier general.

(Continued on page 26)

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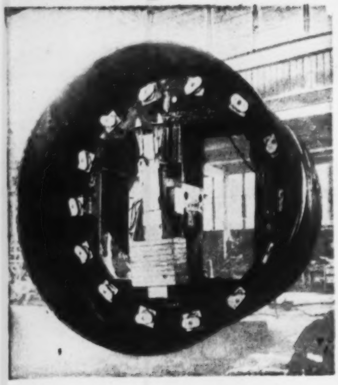

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Albert Haertlein was given an Award of Merit "in recognition of his long and outstanding service to the engineering profession" by the Engineering Societies of New England on February 25. An authority on the mechanics of structures, he is currently associate dean of engineering and applied physics and Gordon McKay Professor of Civil Engineering at Harvard University. Professor Haertlein is an Honorary Member of ASCE which he served as Director from 1946 to 1948 and Vice President, 1950 to 1951.

Robert G. Lenz has been named assistant chief engineer of the Moretrench Corporation, of Rockaway, N. J., and of its associate company, the American Dewatering Corporation. He has been a member of the engineering department for the past seven years.

Lorenz G. Straub is the first person from North or South America to be selected as an honorary member of the International Association for Hydraulic Research and only the fifth honorary member in the association's 23-year history. Dr. Straub, director of the St. Anthony Falls Hydraulic Laboratory and head of the University of Minnesota Civil Engineering Department, was association president from 1948 to 1955.

Richard H. Tatlow, III, was recently elected president of the American Institute of Consulting Engineers. Mr. Tatlow, who is president of Abbott, Merkt & Company, New York City engineers and designers, is a former president of the Society's Metropolitan Section. **Gerald T. McCarthy,** partner in the New York firm of Tippetts-Abbett-McCarthy-Stratton and **Harold M. Lewis,** consulting engineer of New York City, are vice presidents of the Institute. Others elected as members of the Governing Council include **John G. Frost,** partner in the Montreal firm of Wiggs, Walford, Frost & Lindsay and **Ray E. Lawrence,** partner in the Kansas City (Mo.) firm of Black & Veatch.

E. Per Sorensen recently became an associate partner in the New York engineering and architectural firm of Tippetts-Abbett-McCarthy-Stratton. Mr. Sorensen has been a member of the staff for a number of years.

Meissner Engineers, Inc., of Chicago, have opened a branch office at Juneau, Alaska. Present work in that new state includes design of 60 miles of primary highway from Eureka to Tanana.

Fred N. Van Kirk has been named manager of the recently opened Silver Spring, Md., branch office of Consoer, Townsend & Associates, consulting engineers of Chicago, Ill. Until recently he was sanitary engineer with the firm.

A. N. Vanderlip, New York City consulting engineer, announces that arrangements have been made to continue the consulting engineering practice of the late Col. F. W. Scheidenhelm at 50 Church Street, Suite 1380, New York, N. Y. Mr. Vanderlip was an associate of Colonel Scheidenhelm for several years prior to his death.

H. J. Brunnier, since 1908 a consulting structural engineer in San Francisco, is a member of the Rotary International Finance Committee for 1958-1960. Through the years he has served the world-wide service club organization in various capacities including the presidency. Two years ago he was made an Honorary Member of ASCE.

Eli Werner Cohen has been admitted as an associate and assistant chief engineer to Paul Rogers & Associates, Inc., consulting engineers of Chicago, Ill. This is in line with company policy that staff engineers become Associates after successfully passing the State Structural Engineering Registration Examination.

Emil F. Vranich announces formation of the consulting engineering firm of Emil F. Vranich and Associates, Inc., at 625 N. Milwaukee Street, Milwaukee, Wis. Mr. Vranich formerly held the position of president of Collings-Vranich and Associates, Inc., which has terminated its practice.

John R. Hartley was elected president of Builders-Providence, Inc., a division of B-I-F Industries, of Providence, R. I., at a recent meeting of the board of directors. Since joining B-I-F in 1929 as an apprentice draftsman he has served as sales engineer, manager of project sales, general manager of the Builders-Providence division and most recently as president of that subsidiary.

G. Robert Schwarz has returned to Portland, Ore., as a member of the Corps of Engineers, after a two-year assignment in Central America which included work on the Rama Road in Nicaragua for the Bureau of Public Roads. Prior to this assignment he was employed for over four years in the bridge department of the Oregon State Highway Commission.

Harry Ellsberg, chief structural engineer of Giffels and Rossetti, Detroit, since 1954, as winner of the 1959 Concrete Achievement Award, sponsored by the Huron Portland Cement Company, has been cited for his use of concrete in such prominent Detroit structures as Cobo Hall and the new United States Post Office building under construction on West Fort Street. His 46 years of professional experience include structural engineering on such projects as the Ford Bomber plant, the Dodge Chicago Aircraft Engine Plant, and the Hanford (Wash.) Atomic Energy Plant.

Robert P. Lathrop has joined with **A. Bruce Onderdonk** to form Onderdonk and Lathrop, consulting structural engineers, with offices at 2512 Main Street, Glastonbury, Conn. Mr. Lathrop has been associated with Mr. Onderdonk since 1955 when he joined A. B. Onderdonk & Associates.

Jean L. Vincenz, since 1947 director of Public Works of San Diego County, Calif., is the new president of the American Public Works Association. Elected vice-president is **Frederick W. Crane,** for the past 10 years general manager of the Buffalo (N.Y.) Sewer Authority.

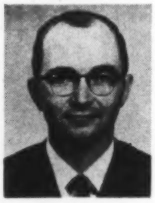
Alfred R. Goldstein recently accepted appointment to the seven-member New Rochelle (N.Y.) Urban Redevelopment Advisory Committee. In 1952 Mr. Goldstein formed his own real estate concern, Elk Realty, Inc., New York City, after two and a half years with Harrison and Abramovitz on the construction of the United Nations Building.

John O. Reeve and **Art V. Maxwell** have been named vice president for design and vice president for field operations of Nielsen, Reeve & Maxwell, Inc., of Washington Terrace, Utah. In addition they will serve on the firm's board of directors with ASCE members **Joseph E. Lawrence** and **J. Dean Hill.**

Horace W. McCurdy has been named "Outstanding Civil Engineer of the Year" by the Seattle Section. His many professional affiliations include the chairmanship of the board of the Puget Sound Bridge & Dry Dock Company, and the board of the National Bureau of Shipping.

Willard O. Wilcox, civil engineer with the New England Division of the Corps of Engineers at Boston, Mass., is retiring from government service on April 15 after 32 years of continuous service with the Corps of Engineers. During a 12-year tour of duty in the Alaska District, from 1944 to 1956, he was chief of the Planning Branch. Mr. Wilcox will make his future home on the shore of Lake Mitchell near Cadillac, Mich., where he plans to continue practicing engineering.

C. E. Eubanks, formerly superintendent of the water division of the Knoxville (Tenn.) Utilities Board, has joined the Mid-South Engineering Company, Inc., consulting engineers of Knoxville, as chief engineer in the water supply and waste disposal division.



William H. Bierschenk, for the past three and a half years geological engineer at the General Electric Company's Hanford Atomic Product Operation, has joined the Frank E. Basil Company, Inc., as office engineer and principal geohydrologist in their Tehran, Iran, office. In his last position, Mr. Bierschenk had charge of geohydrological research in radioactive waste disposal.

(Continued on page 28)

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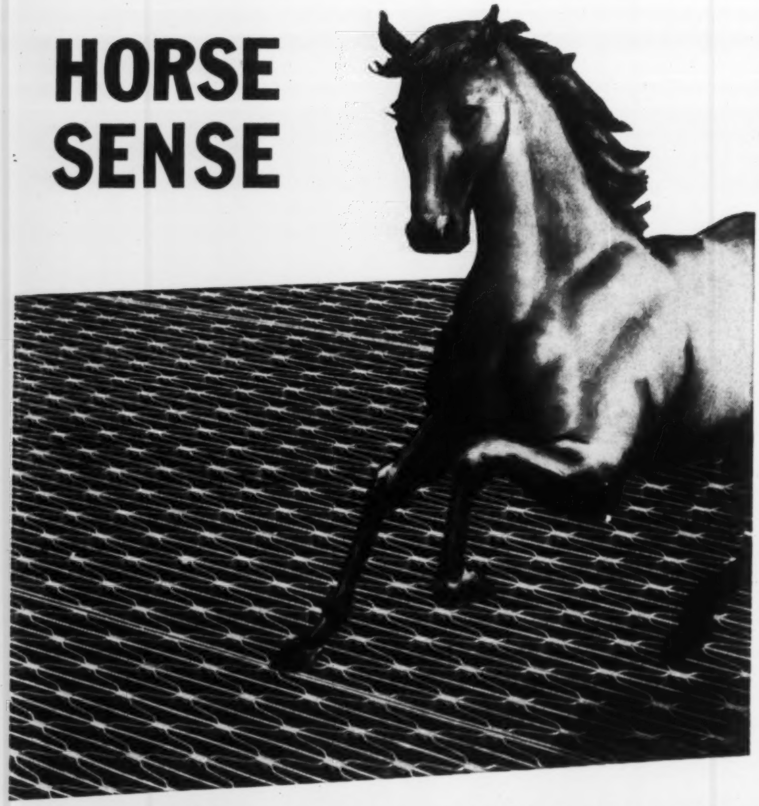
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Clyde N. Baker, Jr., has been elected vice-president of Soil Testing Services, Inc., consulting soil and foundation engineers with principal offices in Chicago, Ill. For the past few years, Mr. Baker has been soil engineer with the firm.

Samuel M. Bailey, until recently chief of the engineering division of the U. S. Army Louisville (Ky.) Engineer District, has been appointed federal representative to the Wabash Valley Interstate Commission by President Eisenhower. The Commission was established by the Wabash Valley Compact.

William R. Jehle recently joined the staff of the Tonawanda Laboratories of the Linde Company, a division of the Union Carbide Corporation, and is presently working as a member of the Piping Design Section of the Engineering Laboratory. Prior to joining Linde, he worked for two years as a field engineer for the Fluor Corporation, Ltd.

Tim Ho, recently appointed first director of Hawaii's new State Department of Transportation, has named **Sam O. Hirota** as his deputy director. The Department of Public Works, which Mr. Ho formerly headed and Mr. Hirota served as assistant superintendent, was abolished and the new transportation department created as part of governmental reorganization under statehood.

Tim Ho

S. O. Hirota

John R. Teerink has been promoted from hydraulic engineer for the California Department of Water Resources to head of the Department's Southern California District office in Los Angeles. Since joining the Department in 1946 he has been engaged on various phases of planning and construction on Feather River and Delta Diversion Projects.

Earl E. Mayo, retired recently after 53 years of service with the Southern Pacific Railroad and its pipeline affiliate. His last position was as vice-president of the affiliate, Southern Pacific Pipe Lines, Inc., at Los Angeles, Calif.

Alfred W. Maner has left the Virginia Department of Highways, where he was assistant materials and tests engineer, to become headquarters staff engineer at the Asphalt Institute in College Park, Md. Mr. Maner has gained additional experience as a highway research engineer and soil mechanics instructor at the University of Virginia.

[*Editor's Note:* Theodore J. Kauer has been named director of the Ohio State Department of Public Works. Through an error that is much regretted he was incorrectly listed as director of public roads in the February issue.]

GALION® 12-Ton Pneumatic-Tire Roller

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Only Galion offers EQUA-MATIC front end construction

Through the automatic balancing action of three king pins, safe roller support is always assured when working over uneven or sloping ground. Galion's exclusive EQUA-MATIC design provides an equalizing movement straight up and down of all five steering wheels, and an oscillating up and down movement of the end wheel pairs. Thus, firm compacting contact is maintained with the surface at all times by the five wheels.

plus 18 other important features

- ROLL-O-MATIC or standard gear shift drive.
- SYNCHRO-MESH transmission.
- UNITIZED assembly provides easy access and servicing.
- AUTOMOTIVE-type hydraulic steering.
- LARGEST ballastable capacity in relation to overall size—in excess of 24,000 lbs. total weight with wet sand ballast.
- EIGHTY horsepower gasoline engine.
- HEAVIEST construction—8,400 lbs. metal weight.
- LOW center of gravity.
- 100% COVERAGE—treads of the nine tires overlap.
- WIDE RANGE of speeds—same range forward and reverse.
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- DOUBLE drive chains to each pair of drive wheels.
- FOUR-WHEEL hydraulic service brake and independent parking brake.
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SYNCHRONIZED 5-WHEEL STEERING

Each of the five steering wheels is adjusted to always steer in its own true arc. This design eliminates the pushing and gouging of material which results when no provision is made to compensate for arcing variations in multiple-wheel steering.

EASY SERVICING

Unitized assembly permits each wheel and wheel brake to be serviced individually, as well as the oil-tight double drive chains. The entire power train can be removed as a unit.

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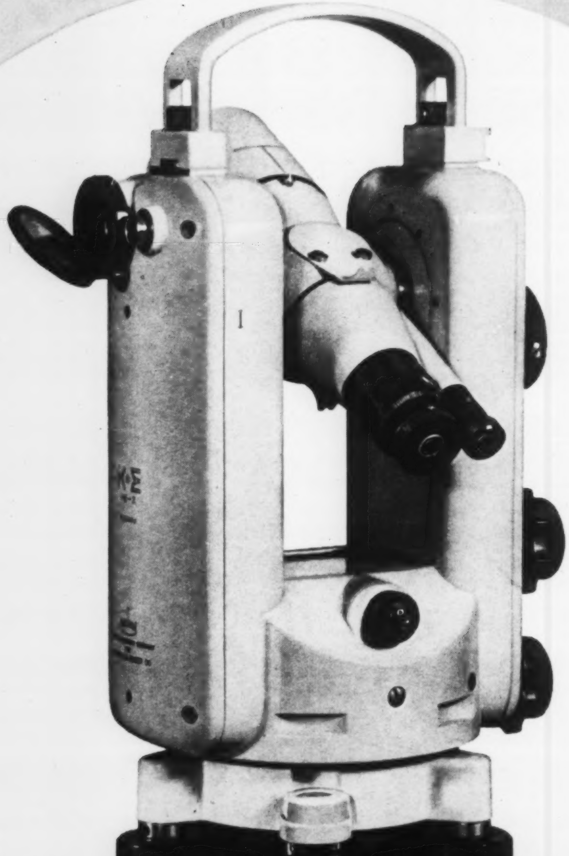
now THEODOLITES...

by K+E



Keuffel & Esser Co. proudly introduces three exceptional new Theodolites...

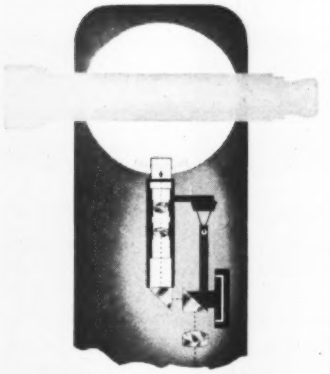
The KE-2, reading direct to one second

The KE-1, reading direct to 20 seconds

The KE-6, reading direct to one minute

In performance and manufacturing excellence, we at K&E regard these theodolites as among the major achievements in our 93 years of instrument experience. They are built in Germany to K&E specifications and standards by world famous Askania-Werke AG.

Engineered For American Practice



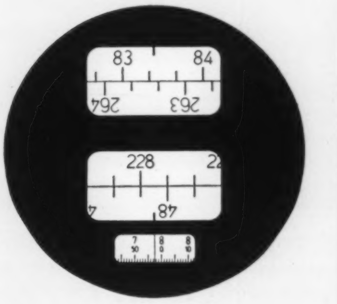
SPEED AND ACCURACY

A built-in pendulum system provides automatic indexing of the vertical circle thereby eliminating an operating step necessary with other design systems. By removing the need to check and re-check a vertical control level, K&E Theodolites are not only faster to use, but far less prone to reading errors caused by drifts in a level.

Theodolites designed in Europe, even those widely used in the United States and Canada, have inherently reflected the patterns of European engineering practice. K&E Theodolites however, embody a *new* set of concepts. These three K&E models are the first and only optical reading instruments of this type conforming to American practice. Seven major improvements—a combination exclusive with K&E—characterize the line:

• **Automatic indexing of vertical circle** . . . pendulum system eliminates need for vertical control level, assures accurate vertical angles. • **Choice of erected or inverted image** . . . with either, telescope plunges through both objective and eyepiece ends. • **Leveling head joint system** . . . ball and socket linkage prevents shift between plates, gives instrument a permanently rigid leveling base. • **All control knobs located on one side** . . . for rapid, one-hand operation. • **Simultaneous viewing of both circles** . . . provides faster, easier reading, eliminates the need to switch-over from one circle to the other. • **Optical plummet built into the alidade** . . . affords easy checking simply by rotating 180°. • **Fully interchangeable accessories** . . . designed to work with all K&E Theodolites, eliminating costly duplication.

Model KE-2

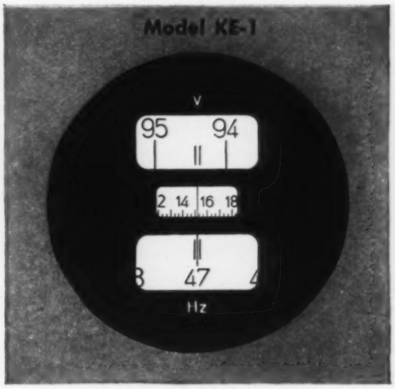


Horizontal Reading — 228° 17′ 57.6″

Directional Theodolite

- direct reading — 1 second
- estimation — 0.1 second

Model KE-1

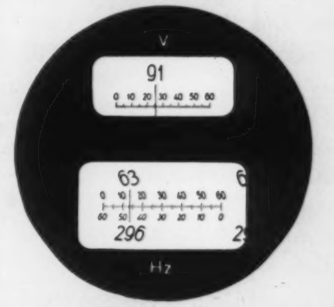


Horizontal Reading — 47° 15′ 12″

Repeating Theodolite—Zero setting

- direct reading — 20 seconds
- estimation — 2 seconds

Model KE-6



Horizontal Reading: clockwise — 63° 13.6′, counter clockwise — 296° 46.4′ vertical reading — 91° 25.4′

Repeating Theodolite—Zero setting

(comparable in operation and performance to the standard American transit)

- direct reading — 1 minute
- estimation — 6 seconds
- horizontal circle graduated 360° in both directions

K&E Theodolites are available for immediate shipment in the United States and Canada. Contact your nearest K&E dealer for information – or write directly to Dept. CE-4, Hoboken, N. J., for descriptive literature.

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2027

LA's first skyscraper is high-strength bolted

The California Bank, at Sixth and Spring Streets, is the first commercial building in downtown Los Angeles that can be called a skyscraper. Its 18 stories rise 267 ft, towering well above the previous 150-ft restriction.

Time and money were saved in erecting the steelwork because Bethlehem High-Strength Bolts were installed quickly, with two-man teams.

Supplied in a full range of sizes for every construction need, Bethlehem High-Strength Bolts are made of carbon steel and heat-treated to meet ASTM Specification A-325.

Try Bethlehem High-Strength Bolts on your next job. Write us today, or ask our nearest Bethlehem sales office for full information.

Architect and engineers: Claud Beelman & Associates; *consulting structural engineers:* Brandow & Johnston; *general contractor:* C. L. Peck Construction & Realty Co.; *interior floor design:* Henry Dreyfuss; *fabrication and erection:* Bethlehem Steel Co.

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STEEL

28 miles at sea-
RAYKAY
1

Code name for a Raymond joint venture, Raykay 1 is the unique deep-water oil loading depot now being built 28 miles offshore in the Persian Gulf. It is scheduled for completion about March 1961, and is designed to speed Iraq's oil exports by eliminating congestion at the port.

A $15,000,000 project

This great terminal literally took off eight months ago, when it floated out from England behind a towline that would eventually carry it 7,000 miles to its final berth.

Twelve hundred feet long and complete with heliport and air conditioned crew quarters, Raykay 1 will be linked to Fao, its source of supply, by two 32-inch submarine pipelines. Two 65,000-ton tankers at a time will be able to load without having to navigate the shallow waters of the river leading to the present port. And the creative engineering of Raymond International is helping to make this possible.

Whatever your offshore problems, no matter how deep or distant, take advantage of Raymond's experience in many seas, in many parts of the world. We have the knowledge and the equipment, and we'd like to help. Write or call any of Raymond's offices throughout the world.

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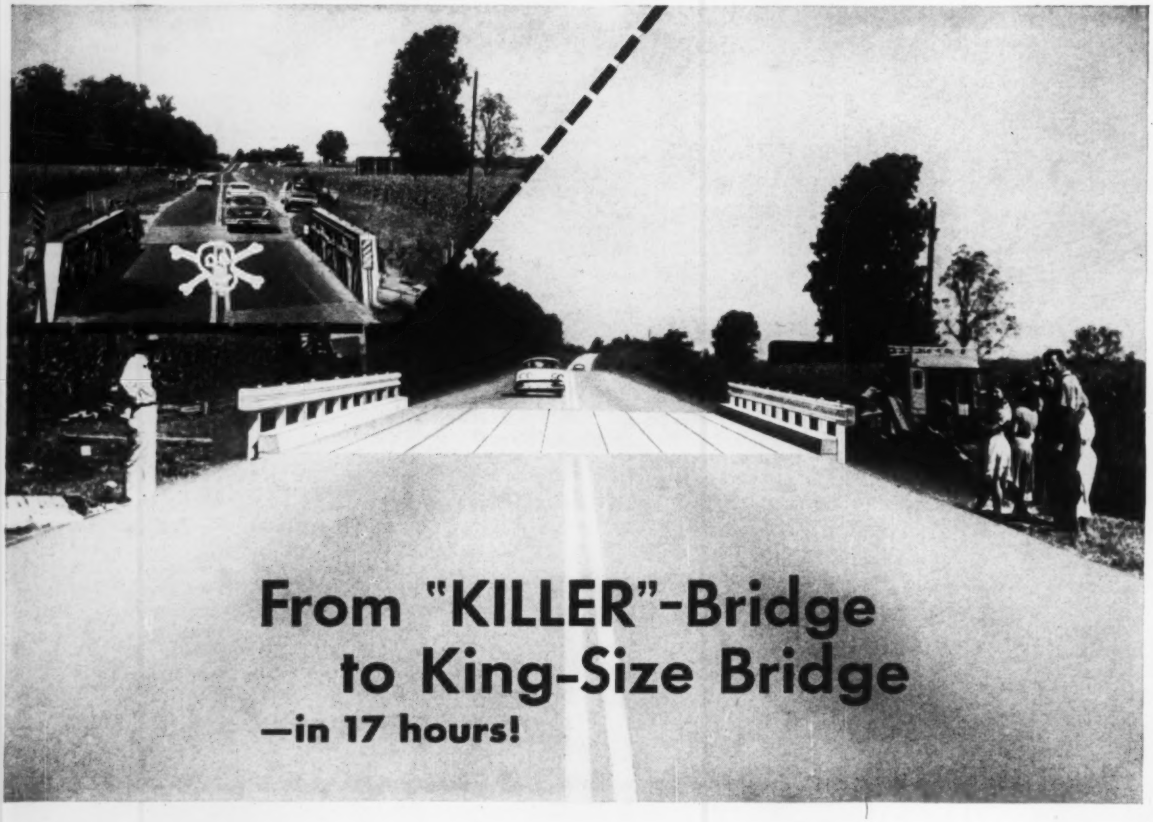

with A-M Concrete Bridge Beams

Only 17 hours were required by the Indiana State Highway Department to eliminate a deadly old "Killer" Bridge and replace it with a modern, wide structure near Scottsburg, Indiana. This new Amdek Bridge is not only safer to cross but is constructed of maintenance-free concrete.

American-Marietta Company makes precast concrete beams for spans up to 36 feet and prestressed beams for longer spans. All are economical and made under factory-controlled conditions—delivered to the job quickly from American-Marietta plants strategically located throughout the nation.

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ALLIS-CHALMERS

One of three 96-inch **Howell-Bunger** valves in operation at the U. S. Engineers Mud Mountain Dam, White River, Wash.

2 ways to air-cushion a big splash

...and provide easy regulation of free discharge

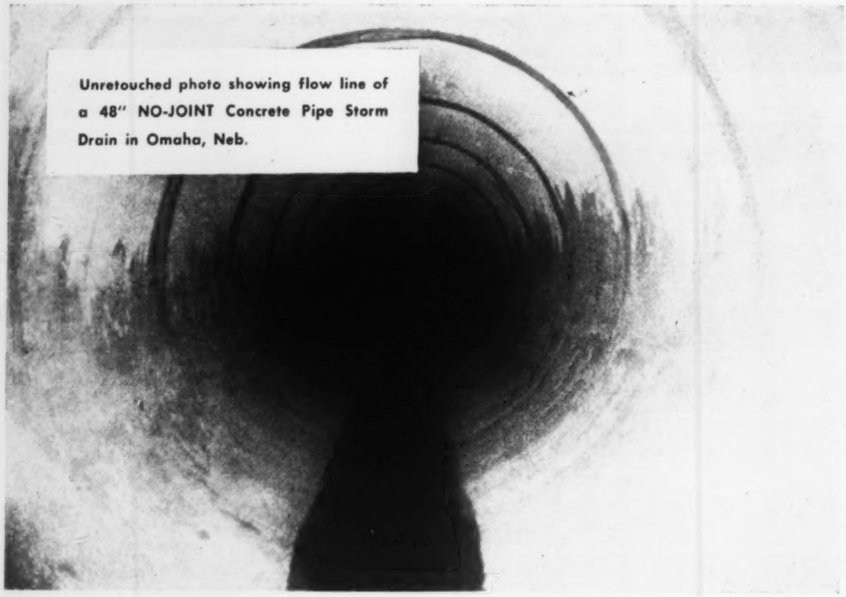
Howell-Bunger valves produce an expanding, aerated water jet that dissipates tremendous energy with minimum erosion and cavitation — and virtually no vibration. They're ideal for free discharge with high to low heads, into atmosphere or water. Lowest in initial cost ... economical to install (need pipe line or conduit of *minimum* size). Only one moving part in contact with flow.

Ring-Jet valves yield a concentrated, aerated jet, perfect for locations requiring reduced spray. A logical development from the *Howell-Bunger* valve, they offer many parallel advantages ... are equally suited to high and low heads.

Only Allis-Chalmers is geared to equip complete hydro installations — turbines, generators and auxiliaries. Contact our office in your area for information. Or write **Allis-Chalmers,** *Hydraulic Division, York, Pennsylvania.*

A-1256

One of two RING JET valves used for irrigation bypass from Tulloch Dam, California.



Unretouched photo showing flow line of a 48" NO-JOINT Concrete Pipe Storm Drain in Omaha, Neb.

Smoother Flow through NO-JOINT Concrete Pipe!

CONTRACTORS: Are you making the *profit* you should on concrete pipe installations?

Here is how you can *increase profit,* and still have *low bid* on the big jobs: When you install *100% perfectly bedded* NO-JOINT Conduit you produce a *highest quality* product at *lowest cost.* You *eliminate* the high cost of *back filling and tamping* to the spring line. There's no hauling and handling of pipes, and less trenching, backfilling, black top and labor cost is *greatly reduced.* There are *no pipe inventories* to maintain; *no capital investment inventories* to tax!

NO-JOINT can put you in the concrete pipe manufacturing business for as little as $15,000. When you are a NO-JOINT distributor, you add *manufacturer's profit* to your normal contractor's profit!

Don't delay. *Write today* for information on NO-JOINT *licensed territories* or *rental* of NO-JOINT equipment.

ENGINEERS: Cast-in-place, Roman arch design NO-JOINT Concrete-Pipe can *save up to 30%* of your concrete pipe dollar! *Saves on maintenance,* too, because there are *no joints to spring leaks.*

NO-JOINT Conduits have the *smoothest flow line;* efficient, clean-line design all the way! *Hundreds of miles* of NO-JOINT pipe now in use for storm drains, sanitary outfall sewers, culverts and irrigation projects. Sizes from 24" up to 72" ID.

Flexural strength of extruded NO-JOINT Concrete Pipe is *uniform* throughout its length. Bearing loads are *uniformly resisted* and *joint leaks eliminated.*

Government Engineers: save taxpayers up to 30% on concrete pipe projects! Use the savings for *additional* needed sewers or storm drains.

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FREE CATALOG: **Large, colorful catalog graphically describes the NO-JOINT Cast-in-place process. Write for your free copy today.**

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Colorado No-Joint Concrete Pipe Co.,
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Highway Construction Co.,
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. . . . . Am-Soc Briefs

▶ ▶ Make your travel plans now. . . . With all America on the move in the good old summertime and with Reno an ever-popular vacation spot, the Convention-goer will want to be sure of his reservations for the Society's forthcoming (June 20-24) Reno Convention. There are three "official" hotels--the Mapes, the Riverside, and the Holiday--to choose from. A form to facilitate registering at any one of them is provided on page 135. The detailed Convention program will be printed in the May issue.

▶ ▶ June 22 is the target date, incidentally, for completing the ASCE campaign for the United Engineering Center fund. It is the hope and aim of the Board of Direction--expressed at its New Orleans meetings--to complete the drive by the time of the Reno Convention. However, it was emphasized, the drive will continue as long as necessary to reach the $800,000 goal set for ASCE. Thirty-five Sections have now gone over the top, giving the forty-three others a challenge to speed up their drive. The forty-three, with the amounts needed to complete their quotas, are listed in the UEC story in this issue.

▶ ▶ Not every day or every year, for that matter, is a new ASCE award established, so it is a matter of moment that rules for two new awards were set up by the Board at its New Orleans meetings. The Professional Achievement Award, endowed by former ASCE Director and Vice President Edmund Friedman, will go annually to an ASCE member judged to have contributed substantially to the status of the profession. . . . Assistant Secretary E. Lawrence Chandler will receive the first award at the Reno Convention. . . . The other new award, the Theodore Von Karman Medal--established by friends and admirers of Dr. Von Karman, an Honorary Member of ASCE--will go for distinguished achievement in engineering mechanics.

▶ ▶ Another highlight of the Board meetings was the confirmation of the St. Lawrence Seaway and Power Project as Outstanding Civil Engineering Achievement of the year in the first award in an annual series recently established by the Society. The runner-up, the Allegheny County Sewage Disposal System, received special Honorable Mention. Story and photo on page 76.

▶ ▶ Weather modification. . . . Papers from the August 1959 Weather Modification Conference, which reviewed accomplishments in the field in the thirteen years since cloud seeding was first tried, are now available in the March Journal of the Irrigation and Drainage Division. The Journals may be ordered, at a list price of $3.00, by use of the regular Technical Division coupon on page 167.

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Duralar:

WON'T SMEAR ON MYLAR - ERASES ON MYLAR

Specifically designed to work perfectly on matte-surface drafting film of Mylar®, Duralar is the newest in the complete line of Mars fine drafting products. All are imported from West Germany and are made to meet the highest professional standards. Shown: Mars-Lumograph Duralar pencil and lead—available in five special degrees, K1 to K5; Mars-Duralar Technico with adjustable Duralar degree indicator; Duralar eraser.

® T.M. for duPONT's Polyester film.

the pencil that's as good as it looks **MARS**

J.S. STAEDTLER, INC.
HACKENSACK, NEW JERSEY

do you know that

Russia is trailing the U. S. in the production of electric power? The latest Soviet Seven-year Plan calls for installation of some 60 million kw of capacity by 1965, bringing Russia's total to about 113 million kw. Our output by 1965 is expected to be 250 million kw. This means that the current gap of 107 million kw between U. S. and Russian power capacities will have increased to about 137 million kw by 1965. These facts were brought out at the recent winter general meeting of the American Institute of Electrical Engineers. The speaker was Charles E. Elbe, president of Consolidated Edison and one of the group of utility executives who toured Siberian electric installations last summer under sponsorship of the State Department.

■ ■ ■

American business firms employ about 780,000 engineers and scientists? Data compiled for a National Science Foundation Survey, to be released this spring, show that this was the number employed in January 1959. Aircraft and aircraft parts, electrical equipment, and chemicals and allied products led other industries in employing scientists and engineers. About 35 percent of the total were engaged in engineering and scientific research and development activities.

■ ■ ■

Civil engineering enrollment is in the lead in Canadian universities? The annual tabulation of university engineering enrollment made by the Engineering Institute of Canada shows civil engineers in the lead at the close of 1959 with 822 registrants, electricals next with 617, and mechanicals third with 515.

■ ■ ■

The St. Lawrence Seaway is carrying far more traffic than the old St. Lawrence canals? Figures for the 1959 navigation season show that 20,100,000 tons of cargo went through the Seaway (Montreal-Lake Ontario), an increase of 8,300,000 tons, or 71 percent, over the cargo carried through the old canals in 1958.

■ ■ ■

Concrete can be made harder by atomic radiation? A method of treating portland cement concrete with atomic radiation has been developed at Brookhaven National Laboratory. The method—reported in the January issue of *Rock Products*—calls for mixing the cement with both a hard metal, such as titanium oxide, and a softer binder metal, such as powdered nickel, then exposing the mixture to gamma rays. The metallic skeleton formed throughout the concrete is said to make steel rod reinforcement unnecessary.

■ ■ ■

Free World spending on highways was up again in 1959? For the twelfth consecutive year expenditures for highway construction, maintenance, and administration increased—from $17.13 billion in 1958 to $18.6 billion. Expenditures in the U. S. were up 10 percent, to a record $10.96 billion. Canada, with expenditures of $1.19 billion, took second place, replacing West Germany, which was one of the few countries to record a decrease from 1958. Spending in Asia and Africa rose sharply, but South America's was off 21 percent. Statistics are from the International Road Federation.

■ ■ ■

This may be our most prosperous year? As the Department of Commerce foresees it, the Gross National Product—currently at an annual rate of around $480 billion—is expected to reach the half-trillion-dollar figure by midsummer.

■ ■ ■

Fluorescent lighting will help ease the traffic jam at the Panama Canal locks? This April, 24-hour operation of the Canal's three great locks—Pedro Miguel, Miraflores, and Gatun—will begin, following installation of 1,300 fluorescent fixtures. According to General Electric, which is supplying the lights, the locks will be as bright as a well illuminated city street. The decision to keep the Canal open all night resulted from the postwar increase in the number of ships using it—from 6,000 a year to about 10,000 in 1959.

■ ■ ■

Successsful construction means knowing how to cope with the weather? The materials that will withstand the rigors of hot-wet and cold-wet climates and how to handle them will be treated in two articles, the first scheduled for May. The author is Capt. Palmer W. Roberts, of the Navy Civil Engineer Corps, who has directed construction all over the world under adverse weather conditions.

water

comes in oceans, rivers, lakes, wells,
drops, buckets, pitchers and glasses.
it quenches thirsts, cooks food, puts
out fires, makes coffee and
brushes teeth. it spins mills,
runs electro-plants, cools motors
and power factories.
it spawns fish, sprinkles lawns,
floats boats, washes children
and grows flowers.

it sustains and nurtures.
it bends if you give it purpose.
it reshapes itself if you give it reason.
it is needed, wanted, feared,
praised and prayed for.

it is at the heart of all life.
it is in the arteries of all industry.
it is as close to us as skin
but as taken for granted as sky.

the end of water seems unbelievable.
if it is not on the horizon, it is just over it.
if it is not within sight,
it is just 'round the bend.
if it is not in the glass,
it is just in the spigot.

. . . this is the grand mirage . . .
the self-delusion that prevails
though the wells run low
and the streams go dry
and the water slips away.

we know water.
we know its ways.
we've learned its habits.
we've pulled it out of swamplands,
pushed it over mountains,
pumped it into deserts,
tunneled it through granite,
and rescued it from pollution.

above all else,
we know the need for it.
that is why,
for 130 years,
we've developed new uses for,
powered new factories with,
diverted the courses of
and jealously stood guard over
water.

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Send for our brochure—"Hydrodynamics." Please write to Mr. Robert W. Kerr, President, Fairbanks, Morse & Company, 600 South Michigan Ave., Chicago 5, Illinois.

CIVIL ENGINEERING

Water purification plant for Charlotte, N.C.

GEORGE S. RAWLINS, F. ASCE, Executive Vice President
J. N. Pease and Company, Charlotte, N. C.

Completion of the new Hoskins Water Purification plant and associated pumping facilities in 1959 marked the attainment of another goal in the long-range water resources program of Charlotte, N.C. This new plant provides an additional 12 million gallons per day (mgd) of water for the homes and industries of this rapidly growing southern commercial center—a welcome supplement to existing facilities capable of treating about 24 mgd. The new plant was put "on stream" in time to meet a summer of record water consumption which reached a peak on June 30 when 38 mgd were supplied to the thirsty city.

To assure that the proposed new additions would meet the prescribed needs as planned, certain criteria were deemed essential. Prominent among these "guideposts" were:

- Production of the finest quality of finished water possible.
- Minimum plant operating and maintenance costs.
- Provision for economical expansion of the plant to its proposed ultimate capacity.

All these were to be accomplished within reasonable initial costs.

Since Charlotte enjoys the great advantage of an abundant supply of first-quality raw water from nearby Mountain Island Reservoir on the Catawba River, its water problem in the past has been mainly financial. Only by adherence to a long-range master plan, kept fully up to date, have necessary treatment and distribution facilities been financed as needed. This has been done without the expenditure of unduly large capital funds for unused future capacity and in the face of record requirements for capital funds by other municipal departments.

The existing treatment plant, known as Vest Station, was activated 34 years ago and together with its several subsequent additions provides treatment, storage and high-service pumping facilities for a nominal rating of 24 mgd of finished water. Limited area at this site made it necessary to relocate the additional treatment facilities.

Raw water is pumped from the Catawba River to two large earthen reservoirs on high ground in the Hoskins district of the city. From there it flows by gravity to the old Vest Station plant for treatment. Multiple gravity lines serve as conduits for this flow. One, of prestressed concrete, is designed for use as a main tie in the future distribution system between the Vest Station area and the Hoskins area.

Site selection

Engineering studies confirmed the advisability of locating all the new treatment works near the raw-water reservoirs and, by means of large-capacity feeder mains looping around the center of the city, serving the large residential areas without the limitations imposed by the heavily built-up downtown distribution complex. Sufficient area was initially acquired to permit new plant expansion to the planned ultimate capacity without congestion. See Fig. 1. Easily accessible rail, vehicular and electrical services added to the economic attraction of the chosen site.

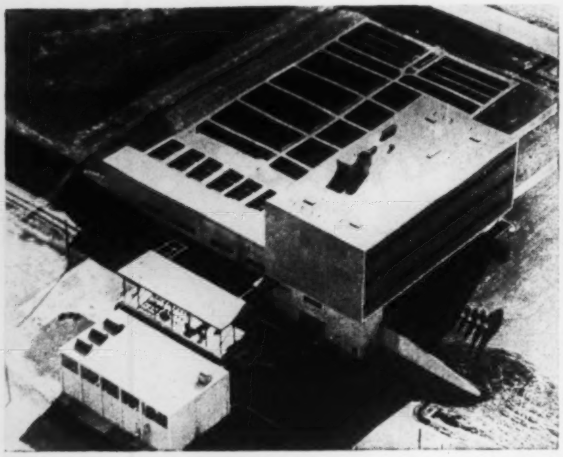
The raw-water booster pumping station was superimposed astride the existing gravity lines from the raw-water reservoirs to the old Vest Station and serves the dual purpose of lifting raw water to the new Hoskins Plant and increasing the capacity of the raw-water lines to the old Vest Station during peak periods. This boosting chore is performed by five electric-motor-driven, low-head, propeller-type pumps (Fairbanks-Morse) ranging in capacity from 6 to 18 mgd. A standby pump (Fairbanks-Morse) of 36 mgd, diesel-engine driven, serves as an emergency unit in case of electric power failure. Check valves are of the tilting-disk type (Chapman Valve, Div. of Crane Co.) with butterfly-type valves (Henry Pratt Co.) for positive shutoff.

The remote stop-start station for the electric-motor-driven pumps is on the main control panel in the Control Building. To alleviate back pressure on these pumps, due to throttling of flow by the regulator valve for the sedimentation-basin level, a pneumatic-operated bypass valve diverts the excess from the pump discharge back to the suction header of the pumps.

Two flash mixing basins arranged in parallel provide a 60-sec period of thorough mixing of the chemicals required for coagulation. Mixers (Philadelphia Gear Works, Inc.) are of the propeller type with 34-in. blades arranged for variable speeds up to about 70 rpm.

The parallel arrangement makes it possible to clean one unit without shutting off all flow to the flocculation basins. Utilizing this parallel arrangement again, two flocculation basins provide 45 min of slow mixing for floc formation. Three rows of slow, variable-speed mixers installed transverse to the direction of flow in the basins provide gentle agitation and mixing with paddle-tip speeds of from 0.5 to 1.8 fps. All drive mechanisms and chain are located in a central dry well separating the two basins.

After passing through perforated stilling walls, the flow enters two parallel sedimentation basins for approximately 4 hours of settling. Conventional cantilever-type wall construction is utilized for both flocculation basins and sedimentation basins. Equally



Hoskins Water Filtration Plant in Charlotte, N. C., is seen from the air.

Corridor in Control Building connects lobby with Central Control Room, beyond glass wall in background.

spaced mud valves at the floor of these basins provide blowoff points for the removal of accumulated settled sludge. After sedimentation, the settled water passes to a battery of four rapid sand filters. Each filter is divided into halves by a common center gullet, with each filter half having its own separate wash-water, filter-effluent, rewash and filter-sweep controls. Controls used in common for each entire filter consist of filter influent, waste, loss-of-head and rate-of-flow indicators.

A common effluent rate-of flow-controller is used for an entire filter. This device consists of a hydraulic insert nozzle and a downstream pneumatically operated butterfly valve (Henry Pratt Co.) actuated and controlled by a prescribed differential pressure from the insert nozzle. It was possible to use this simple flow measuring and controlling device since pneumatic instrumentation and pneumatic operation of the filter valves is employed. When one filter is taken off the line for washing, the effluent rate from each of the remaining filters is increased automatically to compensate partially for this temporary loss of capacity.

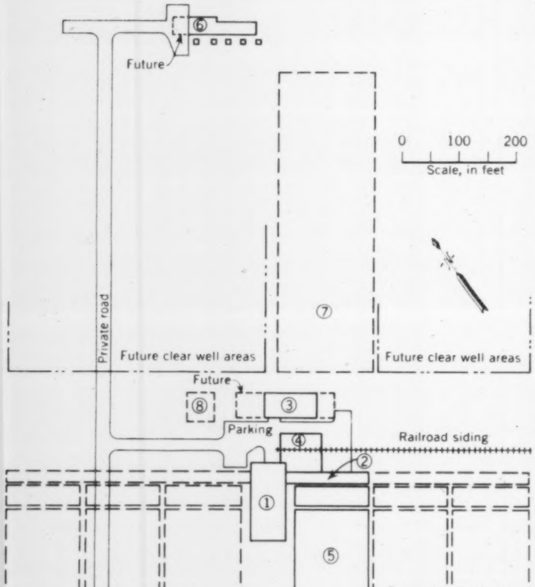


FIG. 1. Site of Hoskins Water Filtration Plant provides for planned ultimate expansion without congestion.

(1) Control Building, (2) Filter Gallery, (3) High Service Pumping Station, (4) Chlorine Platform, (5) Sedimentation Basins, (6) Raw-Water Station, (7) Clear Well, (8) Transformer Pad.

To simplify the filter-gallery piping and, incidentally, to comply with Board of Health regulations which do not permit a common wall between a sedimentation basin and a filter without the use of a waterproof membrane, the filter waste line and valves are placed in a dividing tunnel between the sedimentation basins and the filters. Although the filters are outside the filter-wing structure, no difficulties have been experienced with severe weather conditions. Adequate illumination of the filters permits backwashing during darkness. Conventional cast-in-place Wheeler-type filter bottoms and concrete wash-water troughs are employed.

Storage for finished water is provided in an underground reinforced-concrete clear well with a capacity of 5 million gal. Provisions for the structural connection of an additional well of 7-million-gal capacity were made as were future conduit connections for additional wells on each side. Diversion walls were located within the clear well to prevent dead spaces during storage and use. The well was initially sterilized, after thorough cleansing, by flooding for 48 hours with filtered water having a chlorine residual of approximately 60 ppm.

Finished water passes from the clear well to the high service pumping suction wells, whence it is pumped into the city mains. High service pumping is accomplished by three vertical turbine-type, water-lubricated pumps (Fairbanks-Morse) at a delivery head of approximately 122 ft. Two of these pumps are driven by electric motors, one, a 500-hp synchronous unit, delivering 18 mgd and the other, a 350-hp induction unit, delivering 12 mgd. The third is dual driven by a 300-hp induction motor or by a 330-hp diesel engine, delivering 9 mgd, normally used only when power fails. Cone-type check valves (Hydraulic Div., Allis-Chalmers) are installed on all pumps with butterfly valves for positive shut-off.

A surge relief bypass is incorporated between the pump discharge header and the suction wells to dampen hydraulic surges in case of a power failure. Remote start and stop controls for these pumps are located on the main control panel in the Control Building.

Chemical feeding

For chemical feeding in both pre- and post-treatment, the most direct routing possible for the solution feed piping is used to avoid plugging of lines. Dry-feed gravimetric machines (Omega Machine Co., Div. of B-I-F Industries, Inc.) discharge solutions almost directly downward into the receiving water entirely by gravity. Including standby units, seven gravimetric feeders and one carbon slurry volumetric-type feeder are provided. Suitable alarms, for a feed rate that is either too fast or too slow, rate indicators, totalizers and recorders are included in the installation. The area for dry chemical storage on the third floor of the Control Building is arranged for future pneumatic bulk handling of dry chemicals from rail cars into storage and to the feeder hoppers.

Chlorine, from one-ton cylinders on an outdoor storage platform, is piped to the chlorine feed room in the Control Building. A water-bath type of evaporator assures conversion of the liquid chlorine to its gaseous state at all anticipated withdrawal rates. Gaseous ammonia from 150-lb cylinders is handled by two ammoniators of direct-feed type. Appropriate platform scales with recording loss-of-weight meters are used for both chlorine and ammonia cylinders, and the rate of feed from each of the chlorinators (Wallace & Tiernan, Inc.) is indicated on the main control panel. Manifold piping provides flexible arrangements for solution feeding for both prechlorination and post-chlorination.

Control Building

The architectural treatment of the plant buildings is intended to emphasize the functional character of the treatment units and present a clean, neat appearance. The location of the central control building on high ground adjacent to a heavily traveled highway posed a challenge in that it would be seen by hundreds of visitors each day. Simple yet effective outside illumination was considered highly desirable.

The Control Building houses the facilities for administrative and centralized control, the chemical storage and feeding equipment, the laboratory rooms, mechanical equipment areas, repair shops, housekeeping storage areas, and personnel locker rooms.

To comply with the criteria that the architectural treatment was to emphasize the functional character of the treatment units and to express in some manner the purity of the finished water, a blue-green panel wall was chosen for the sides of the structure. In contrast to this smooth textured appearance, the end walls are large precast concrete panels with exposed colored aggregate. Reasonable initial costs, reduction of maintenance expense and the self-cleansing features of these two materials, as well as the coloring available, weighed heavily in their choice for exterior walls.

Interior finishes were chosen for ease of cleaning and economy of maintenance as well as appearance. Glazed-tile walls and tile or terrazzo flooring are used in areas of heavy traffic, in laboratories and in chemical feeding rooms to facilitate housekeeping and to eliminate painting. The central control room is strategically located to permit viewing of both the existing and the future filter wing as well as the entrance hallway of the main building. Luminous ceiling lighting for this control room assures adequate light without discomfort from glare during extended hours of duty.

The Raw-Water Booster Pumping Station building and the High Service Pumping Station building utilize exposed concrete frames with precast concrete panels similar to the exposed colored-aggregate panels of the Control Building. Ceiling-hung fluorescent fixtures provide interior lighting for these two buildings.

The general control system for the plant is pneumatic but there is some transmission by electric means from remote points. A central control panel provides the operator with a complete picture of the minute-by-minute operation of the plant and the water levels in the elevated tanks throughout the city. The use of such centralized control facilities does not, and was not intended to, relieve the operators of responsibility for insuring the proper operation of all plant equipment by a detailed schedule of rigid inspections. These inspections were felt to be important lest the operators be lulled into a false sense of security by convenient controls and indicator units.

The following units are mentioned to indicate the scope of the controls on the main control panel. Start-stop controls and run indicator lights for the raw-water and the high-service pumping units, high-service discharge flow rate and pressure recorder, raw-water reservoir and clear-well-level recorders are provided for quantity control. Filter processing controls include sedimentation-basin-level, set-point controller, station-rate and filter-rate set-point controller as well as total filter effluent flow and wash-water recorders. Individual filters are taken off the line, washed and put back in service by controls mounted and operated at the separate filter operating tables. Chemical treatment controls and recorders on the main control panel consist of the chlorine rate-of-feed recorder, the multiple-sampling-point pH recorder, and a residual chlorine recorder along with feeder-machine alarms and run indicator lights.

Timely and responsible planning

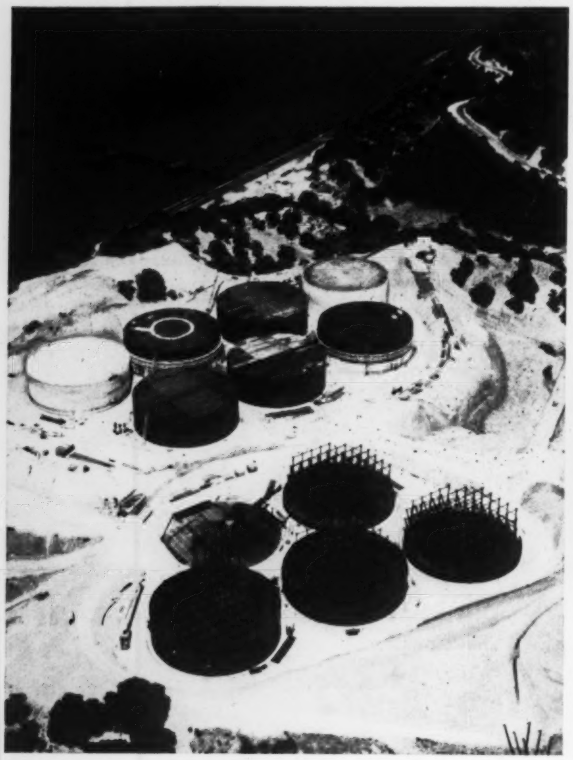
Charlotte is faced with the problem confronting many similar municipalities today—that of providing for the many pressing needs of a rapidly growing urban and suburban metropolitan area. How it met and solved one of these problems—that of supplying high-quality water in ample quantity to meet an ever-growing thirst—has been outlined. Only by long-range planning, kept fully up to date, can such problems be successfully solved before they have adverse effects on the community. With all departments of a city pressing their case for capital funds, it behooves those responsible for water works facilities to be prepared to present a positive, well documented case fully justified by a carefully conceived, well engineered study. The understandable desire to incorporate facilities for future expansion must be tempered by the necessity of keeping initial costs within bounds. Such facilities for future expansion as are included must be fully justified from the standpoint of sound economy.

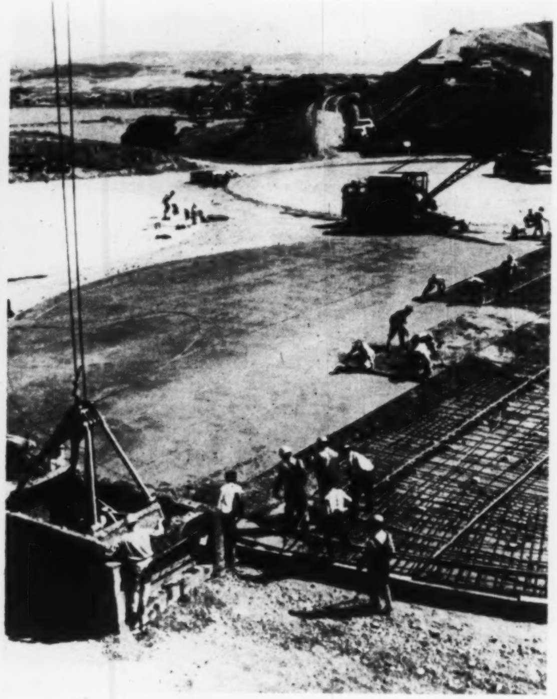
Successful culmination of this expansion phase of the city's water works is due then, as it always will be, to timely and responsible planning, both for today and for tomorrow.

The mayor of Charlotte, N. C., is James S. Smith, and the City Manager, W. J. Veeder, who has succeeded Henry A. Yancey (now retired). The Superintendent of the Charlotte Water Department is W. M. Franklin.

Engineers and architects for the new plant were J. N. Pease and Company, with E. F. Roth, Resident Engineer. Under the general contractor, the Rea Construction Company, the Roberts Filter Manufacturing Company was the subcontractor responsible for the major part of the filter and equipment work.

Steel-lined prestressed-concrete tanks were arranged in two groups. The area around the tanks was backfilled to 4 ft above their tops for complete protection.





To place the concrete floor slab, trucks deposit ready-mixed concrete in boxes adjacent to the slab. Cranes transfer it to placement locations. Steel angle irons are set to floor level and steel liner plate is later welded to these angles.

Leakproof concrete tanks for aviation fuel

JOHN J. CLOSNER, President

MARK M. PORAT, Special Projects Engineer

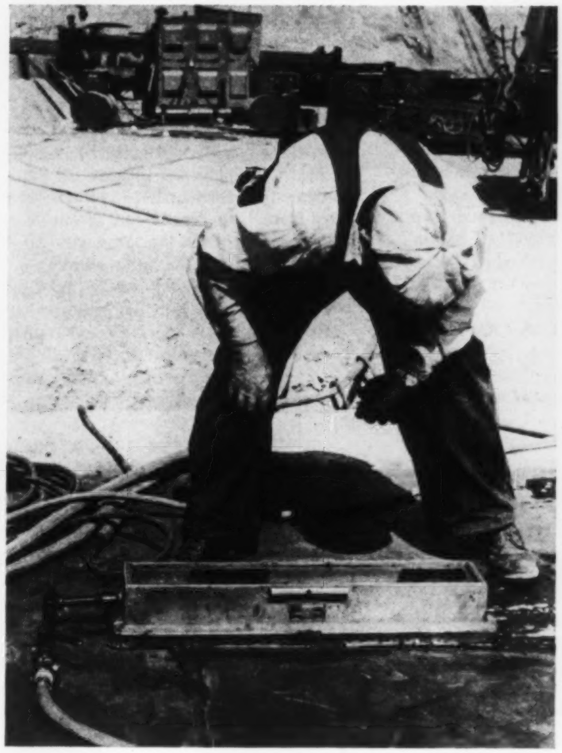
The Preload Company, New York, N. Y.

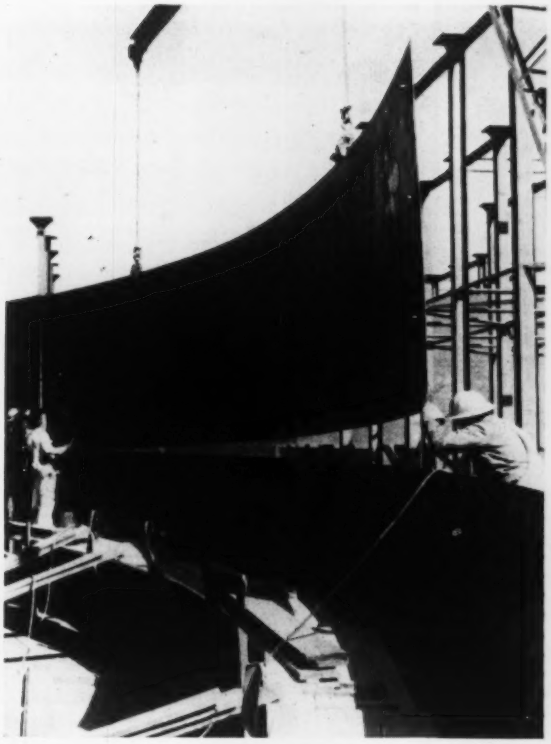
"Absolutely leakproof" was one of the rigid criteria for 12 new underground storage tanks at a million-barrel jet-fuel depot at Ozol, Calif. In addition, the tanks were to be designed to withstand blast loading resulting from a possible nuclear explosion at the earth's surface.

Steel-lined prestressed concrete was selected by the builder as the best medium to meet these conditions. Prestressing was in accordance with the Preload Company's system of helically wrapping the concrete tanks with wire under tension, and was applied under a license issued to the Herrick Iron Works of Hayward, Calif., contractors for the tank construction. The tanks have been under construction for approximately one year and are about ready to go into service. They are owned by the Lark Corporation of Dallas and have been leased on a long-term basis by the Military Petroleum Supply Agency.

The tanks are arranged in two groups to fit the existing sloping to-

To test a welded joint, soapy water is spread on it, rubber-edged glass-topped box is placed over weld, vacuum pump is operated, and any leakage is evidenced by bubbles.





Sections of 8-ft x 40-ft wall liner plate are being placed in position. Columns for roof of adjacent tank appear in background.

pography. Seven tanks are grouped on one level and five are at a lower elevation.

Each of the 12 tanks has an inside diameter of 122 ft 3 in., a clear height of 40 ft, and a net storage capacity of 83,500 bbl. The concrete tanks are completely lined with a ¼-in. steel-plate liner. Joints in the liner plate were butt welded and every inch tested for leakage. Concrete with an ultimate compression strength of 3,750 psi was used throughout.

The subgrade on which the tanks were constructed was capable of sustaining the superimposed loads without appreciable settlement. The entire site was excavated to allow for a 4-ft earth covering over the tanks. A reinforced concrete floor slab 15 in. thick was placed on the prepared subgrade, and this slab supports tank walls, roof-support columns and tank contents.

In addition to reinforcing bars, angle-iron strips were set to accurate floor level with the vertical leg down, before the slab was placed. These angles were prefitted with Nelson anchor studs for secure embedment in the concrete. The steel-liner plate for the floor was subsequently welded to these strips.

Floor slab placed

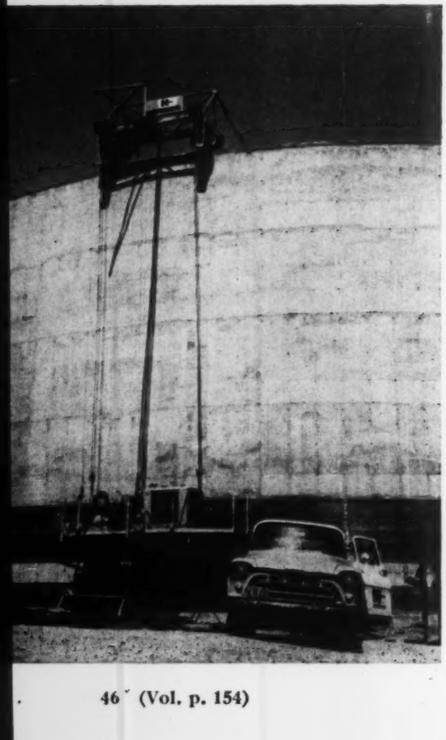
The concrete, delivered to the site in ready-mix trucks, was placed at each tank in one continuous pour. It was dumped in 6-cu yd boxes on opposite sides of the tank. Two cranes used clamshell buckets to pick up the concrete from the boxes and swing it to placing locations. The finished surface of the slab was sprayed with curing compound to seal its surface and control evaporation of water from the concrete during curing. The angle-iron strips were thoroughly scraped and cleaned of concrete in preparation for the setting of the liner plates.

The ¼-in. plates were delivered to the site in sections 30 to 40 ft long by 8 ft wide. The floor plates were set with their edges resting on the angle strips, and were tack welded in position. An automatic welding machine then followed to make a continuous butt weld. All joints were thoroughly tested for leakage and new welds made if necessary.

Roof-supporting columns are of 12 WF 65 structural steel. They are 40 ft high and are spaced 12 ft 6 in. on centers each way. Sixty-nine are used in each tank. The base plates of the columns were welded to the floor liner. The columns are braced against one another at their midpoints by interconnecting structural members. These members were preassembled with the columns so that a column and two braces were erected simultaneously, the other ends of the braces being secured on location. This prefabrication helped to minimize on-the-job steel work. Roof beams were welded to plates at the tops of the columns for support of the roof liner plate and concrete roof-slab. Intermediate purlins also were installed to support the ¼-in. roof plate during concrete placement. Although these purlins are not required as part of the permanent structure, they were

Steel liner for tank walls is fully erected, and concrete has been placed for lower half of wall.

Prestressed wires are applied to tank walls. Preload wire-winding machine suspended from carriage winds wire around tank at about 700 ft per min.



not removed as the cost would not have been justified.

After the columns were erected, the wall liner plate was set in position around the perimeter of the tank to its full height. The plates were delivered to the site shaped to the perimeter of the tank. Plates were set on edge, one on top of the other, and were temporarily clamped in place before welding. Joints were welded from each side of the tank and tested for leakage.

The joint where the wall liner meets the slab liner was welded all around, and a backup angle installed in the outside corner. This construction restrains the horizontal movement of the wall at its base, an important consideration in case of blast loading. At the same time it safely allows for wall rotation at the joint while maintaining a leakproof connection. Thus it allows for the inward forces applied during prestressing and for the outward forces that come into play when the tank contains fuel. A similar hinged-joint connection is provided between the top of the tank wall and the roof slab.

Steel and concrete integrated

Nelson anchor studs were welded in rows to the outside surface of the erected steel liner to anchor the liner plate to the concrete wall. The three upper and lower rows of anchors are ¾ in. round by 4 in. long and are spaced 12 in. on centers vertically and 8 in. on centers horizontally in a diamond pattern. Anchors for the remainder of the tank are of the same size and are placed in a diamond pattern 2 ft on centers both horizontally and vertically.

Following installation of the studs, vertical reinforcing consisting of No. 5 bars spaced 18 in. on centers, was strung from the base of the tank to the top in preparation for concrete placing. The steel liner plate, in addition to providing a leakproof interior for the tank, doubles as reinforcing for the concrete wall. It also acts as the inner form for the concrete.

Outer forms, prefabricated in sections 8 ft high by 16 ft long, and shaped to the outside perimeter, were set and secured in position with Nelson studs threaded to receive a special nut for securing and adjusting the forms. The concrete wall, 9 in. thick, was poured in successive rings.

A reinforced concrete roof slab 9 in. thick tops out the tank. At opposite sides of the tank two manways of 36-in. diameter, provide for tank entry, and the interior tank walls are equipped with permanent ladders. Two vents of 12-in. diameter and two 8-in. gage hatches are also installed. Through pipe openings provided at the bottom of the wall, a 20-in. combination fill and suction, and a 4-in. water draw-off pipe are attached to the bottom of the tank. Flange plates are welded to the liner at all openings to insure against leakage.

Prestressing wires drawn

After each tank was completed, and when the concrete had gained sufficient strength (80 percent of its ultimate compressive strength), prestressing wires were helically wound around the tank wall to offset the pressures later to be exerted by the tank contents.

The self-propelled winding machine used for this purpose is suspended down along the outside wall from a carriage which runs along the outer edge of the roof slab. This carriage is securely guyed by radial cables to the center of the roof.

The Preload winding machine draws a spring steel wire through a special die from an original diameter of 0.192 in. to a diameter of 0.168 in. This produces an initial stress in the wire of 150,000 psi which drops to an estimated 115,000 psi after losses due to creep, shrinkage and plastic flow.

The starting end of the wire is attached to an anchor bolt set in the bottom of the concrete tank and as each 400-lb bundle is wound around the tank, the winding machine is stopped and the end of the played-out wire is securely clamped to the wire previously laid. The leading end of the succeeding bundle is then threaded into the die and connected by a torpedo splice to the end of the installed wire.

To impart the required prestressing forces to the tank, four layers of wires were required around the lower 6 ft, three layers for the next 4 ft, two layers for the next 17 ft, and one layer for the remaining 13 ft. This applies a force that varies from 234 kips per vertical foot at the bottom of the tank to 34.5 kips per vertical foot at the top.

As each layer of wire was wrapped, pneumatic mortar approximately ¼ in. thick was applied to cover and bond the wire. A final coat of pneumatic mortar ¾ in. thick was then applied over the last layer of wire and covered with a waterproof coating. Finally, the tanks were backfilled and preparations were made for placing them in service.

The facility was designed by Barnard and Ancira, Dallas, Tex. The prime contract for constructing the tanks was held by Herrick Iron Works, which furnished the reinforcing and structural steel as well as the prestressed reinforcement. Concrete work was done by Ben C. Gerwick, Inc., and steel-plate work by Yuba Industries and the Pittsburgh Des Moines Steel Co., all from the Bay area.

Seven-mile hot pipeline in Gulf of Mexico

E. J. McNAMARA, M. ASCE, *Project Manager, Grand Isle Mine, Freeport Sulphur Company, New Orleans, La.*

Out into the Gulf of Mexico for seven miles, to a man-made island, runs a pipeline that easily qualifies as one of the most complex in engineering history. This unusual pipeline will transport molten sulphur from the man-made island in the Gulf to the shore at Grand Isle, La. The third largest sulphur deposit in the United States, Grand Isle Sulphur Mine, embraces several hundred acres located about seven miles off the coast of Louisiana where the water is about 50 ft deep. It was discovered by the Humble Oil & Refining Company in 1949. In September 1956, Freeport acquired these sulphur rights by entering into a contract with Humble.

Transportation methods studied

Transportation of the liquid sulphur from the Grand Isle Mine to the storage and loading installations at Port Sulphur was one of the most important problems to be overcome if the mine was to prove successful. Detailed studies were conducted on numerous methods of sulphur transport, some of which were:

1. Pumping the liquid sulphur through a pipeline to Port Sulphur, a distance of 27 miles.
2. Pumping a water-sulphur slurry by pipeline to Port Sulphur where the sulphur would be reclaimed.
3. Use of an aerial tramway carrying insulated tank cars between the offshore mine and Grand Isle, and thence transporting the sulphur in barges to Port Sulphur.
4. Use of barges for liquid sulphur or self-propelled tankers, a method requiring large storage tanks at the offshore mine.

The studies indicated that the most economical, reliable, all-weather means of getting the sulphur to the terminus at Port Sulphur was to pump it in liquid form through a pipeline to Grand Isle, load it into tank barges in quiet protected waters, and tow the barges to Port Sulphur by the inland water route.

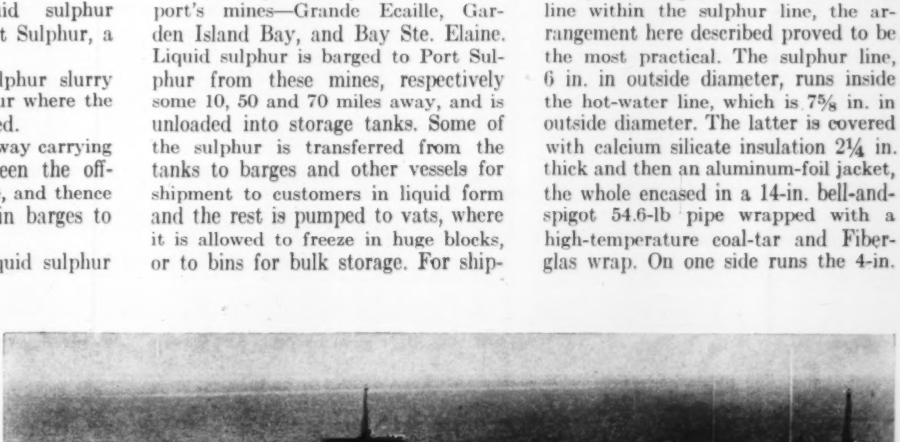
Mining of the deposit will be done by the Frasch process, which requires simultaneous heating of several wells by pumping in sea water at 325 deg F to melt the sulphur. The liquefied sulphur collects at the bottom of the well, whence it is lifted to the surface by air. Several large steel platforms 224 ft x 116 ft will serve as drilling and producing areas for the mining of the deposit. Directional drilling will make it possible to mine an area about 2,000 ft in diameter from one platform.

Sulphur from the Grand Isle Mine will move through the storage and loading installations at Port Sulphur, which are currently used by three of Freeport's mines—Grande Ecaille, Garden Island Bay, and Bay Ste. Elaine. Liquid sulphur is barged to Port Sulphur from these mines, respectively some 10, 50 and 70 miles away, and is unloaded into storage tanks. Some of the sulphur is transferred from the tanks to barges and other vessels for shipment to customers in liquid form and the rest is pumped to vats, where it is allowed to freeze in huge blocks, or to bins for bulk storage. For shipment to customers, this sulphur is broken down by power shovels and conveyed by belt line to railroad cars or to barges and ships in the Mississippi River.

When the method of transporting the sulphur was decided on, the design requirements of the pipeline added up to an ultimate capacity of 4,500 tons per day, with a minimum sulphur temperature at the barge loading point on Grand Isle of 280 deg F. The viscosity characteristic of the sulphur limits its initial temperature to 320 deg F, and sulphur freezes at 240 deg F. Heating of sulphur lines is normally accomplished with steam, but because of the length of the line, the pressure drop of the steam would be too much to keep the sulphur within the prescribed temperature limits. Heated water under pressure was found to be a satisfactory medium when operated between the temperature limits as long as the sulphur and water flowed in the same direction with the same temperature drop.

After considering various economic sizes, including the use of a tracer line within the sulphur line, the arrangement here described proved to be the most practical. The sulphur line, 6 in. in outside diameter, runs inside the hot-water line, which is 7⅝ in. in outside diameter. The latter is covered with calcium silicate insulation 2¼ in. thick and then an aluminum-foil jacket, the whole encased in a 14-in. bell-and-spigot 54.6-lb pipe wrapped with a high-temperature coal-tar and Fiberglas wrap. On one side runs the 4-in.

At offshore "island" of Freeport Sulphur Company in the Gulf of Mexico, here seen from the air, sulphur will be taken from huge deposits 2,000 ft below the ocean floor. In molten form it will be transported 7 miles to the Louisiana shore through an unusual pipeline.



return water line and on the other a cement-lined 6⅝-in. bell-and-spigot line to convey fresh water to the mine platform. The empty sulphur barges returning from Port Sulphur to Grand Isle will carry Mississippi water as ballast, to be used as camp water and for drilling.

Construction program considered

A number of methods were considered for constructing the pipeline:

1. Laying the outer lines as conventional offshore lines, then making up the inner lines on the island and pushing them out to the mine, utilizing pipeline rollers 19 ft 6 in. on centers.
2. Laying all the lines from barges in the conventional way.
3. Making up of the multiple lines on Grand Isle and pulling the assemblies from a launching ramp on the island, utilizing buoys to offset the negative buoyancy.

The third method was selected as it afforded the least exposure to weather, permitted the tedious testing and X-ray procedures to be done systematically, and gave rigid control over trench excavation. This excavation determined the actual "lay" of the line and had to meet almost impossible requirements. The pipeline could not vary from the planned center line by more than plus or minus 3 ft, with a maximum radius of 1,500 ft in either horizontal or vertical control.

The contract for the construction of the line was awarded to Sharman, Allan, Gay and Taylor of Houston, Tex., on March 19, 1959. Preparation of the launching site began on April 1, and actual welding of the lines on May 7.

Selection of modified Jones & Laughlin Steel Corporation's Jalloy No. 1 steel pipe with a minimum yield of 60,000 psi was based on the stresses involved in expansion, the probability of hydrogen sulphide embrittlement cracking, and qualities associated with a hardness of less than 22 Rockwell C. As this was the first time the material had been used for piping, it was necessary to develop a method for successfully welding the pipe, to pass the strength and embrittlement tests and produce a weld that would radiograph satisfactorily.

Welding the pipe sections

After considerable expense and time, by trial and error and by consulting all the experts in the field, a method was finally developed. The standard V-joint on all the pipe furnished from the mill was rebeveled to a J-bevel, and the ends of the 6-in. and 7⅝-in. Jalloy pipe were buffed to bright metal (to avoid any foreign inclusions). Then a solar-flux mixture in methyl alcohol was painted on the inside of the pipe extending one inch back from each joint.

The joints were butted directly together with no space between, and the 1/16-in. land of the U-groove was completely fused by an argon gas-shielded arc-welding process (Heliarc). The first pass following the fusion pass was done with a bare steel rod of approximately the same chemical composition as the Jalloy pipe. The following passes were made with conventional arc welding using low hydrogen rods. The rods were kept in portable ovens at 150 deg F. For the 14-in. casing and the two piggyback lines, conventional arc-welding was used.

The working area available to the contractor was limited by the island's width of 2,300 ft. In this area he had to carry out the necessary testing procedures on the inner lines and be able to insert completed lines one within another. This limited the test lengths to 1,000 and 2,000 ft. Pressure testing followed the 100-percent radiographic inspection of all welds. On completion of the testing of a 1,000-ft string, the 6-in. string was inserted into the 7⅝-in. one by "pulling-in" with winch tractors. Next, the 7⅝-in. was pulled into the 14-in. pipe following installation of rollers and insulation. After two 1,000-ft lengths of multiple units of the 6-in., 7⅝-in., and 14-in. pipe were assembled, they were welded together.

While the welding sequences were in progress, three clamshell dredges were excavating the trench into which the multiple lines would be pulled. Control of excavation, both horizontal and vertical, was assigned to the fathometer crews of Pyburn and Odom, consulting engineers of Baton Rouge. Considerable time was saved by the accurate and detailed survey of the trench by this method. Follow-up and clean-up by the dredges could be spotted instantly and moving of the dredges backward and forward was held to a minimum.

When the dredging was completed, the sixteen 2,000-ft multiple sections were moved onto the launching rack, one section at a time. Additional sections were welded, one to the other, following each 2,000-ft pull into the Gulf. On the adjoining rack, the buoy pipe and smaller lines were welded in the same way. The launching rollers were mounted on sections of sheetpiling with wide guide rollers to accommodate the two "piggyback" lines.

The anchor section at the mine end was fabricated in the Freeport shops at Harvey, La., which permitted all lines to be anchored to each other and then anchored to an outer casing from which the pretensioning pull would be applied. A three-pile terminal structure was set offshore to serve as a support for the riser pipe sections to bring the lines up to the main plant platform.

With all sections welded and all trenching completed, a pull barge was moved onto the pipe centerline. This barge was provided with two 250-ton winches converted to diesel power and with 8-part lines reeved into a vertical sheave on the "nose section" and dead-ended into a dynamometer reading direct to thousands of pounds. Tugs hauled the lines to the beach, where they were attached to the first section of pipeline. Pulling operations were ready to begin.

At this point everyone felt we were "over the hump"; then the trouble really began. The long single lines of cable, which were anchored in the sand, broke on the first pulls. Then the stern anchors on the barge started slipping and the shallow water made anchor and buoy handling almost impossible. Following this, hurricane Debra hit and sanded up a section of the trench near the sheetpile bulkhead in the breaker area. Because of variations in pipe weight, the wrapping and the light negative weight being carried, as well as air pockets that had developed in the outer lines during filling, all buoyancy calculations were upset. In short, it wasn't so easy to pull the pipe as we had supposed. Once out past the sandy beach, however, the line moved very well in the soft clay trench, and pulling was completed in 17 days. After the beach section had been installed, pretensioning of the line was ready to begin. The contract required that all lines be pretensioned to 10,000 psi.

Prestressing the pipeline

The prestress of 10,000 psi is equivalent to a rise of 50 deg F in the outer casing and was selected to keep the casing in tension at all times. This improved the stress condition in the partially suspended sections, reduced the tendency to move, and relieved the shearing stress on the protective coating of the casing.

To accomplish this prestressing it was necessary for the contractor to provide facilities for applying a pull in excess of 260,000 lb on each end, as a steel area of 26 sq in. was involved in the three outer lines. Heavy-duty flanges were welded on each of the three outer lines, and two 200-ton hydraulic jacks were provided, working against a moveable jacking frame anchored against a sheetpile bulkhead on the beach end. The applied pull was held with prestressing cables and locking devices identical to those used in prestressing reinforced concrete. By these means the contractor was able to apply the required pull.

Offshore, a 30-in. pile anchor with two sheaves attached was driven to refusal. Two cables attached to the nose section were reeved through the sheaves and a pull of 260,000 lb was applied by a 250-ton derrick barge. Atop the pile was a beam with Hinterliter slips, which locked in the pull immediately upon release of the strain by the derrick barge. A total stretch of 39 in. was effected in the outside casing.

Following a complete vertical and horizontal survey of the line by the fathometer crews, and acceptance as to its "lay," the contractor removed the buoy pipe sections by flooding and cutting the bands and then blowing out the water and salvaging the sections.

A few job statistics

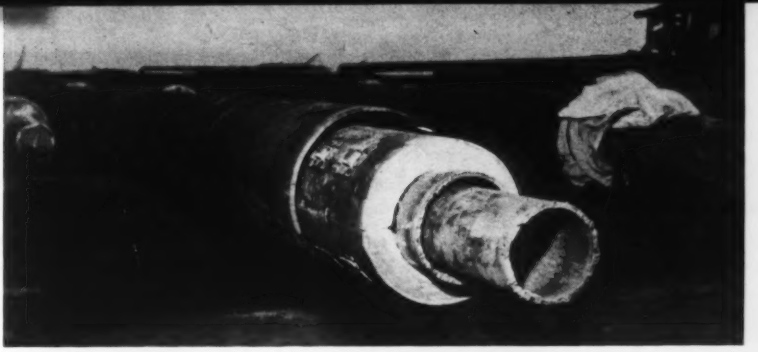
The fabrication period, including preparation of the assembly site, required 52 days. Launching was accomplished in 17 days, and complete adjustment and clean-up in 27 days. A glance at some of the statistics will give an indication of the size of the job:

- Approximately ½ million board feet of lumber went into the site for the fabricating yard.
- A total of 180,000 ft of pipe was fabricated in the yard.
- Approximately 11,000 cu yd of material moved by clamshell was used in preparing the assembly site.
- Over 300,000 cu yd of earth was moved in preparing the pipe ditch.
- Some 48,000 bands were used to band insulation and pipe assembly together.
- 1,700 spacer roller assemblies were welded to the outside of the 7⅝-in. pipe to keep it centered in the 14-in. casing and to permit expansion of the two inner lines.

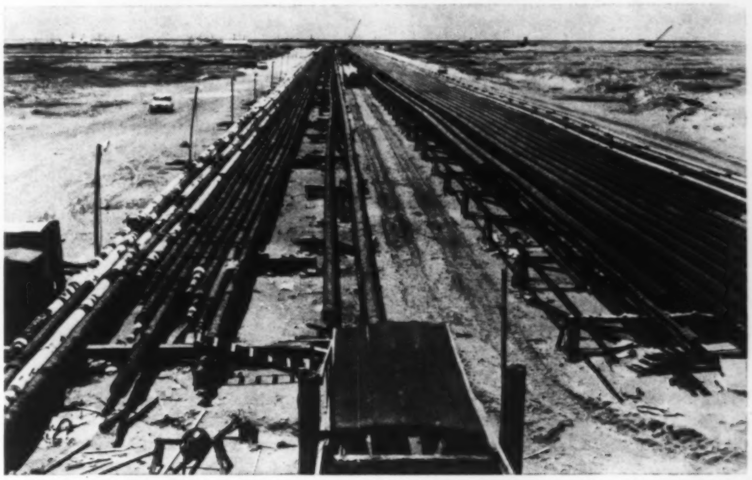
Design of this unique line to carry hot sulphur a distance of seven miles was accomplished by the Engineering Staff of Freeport Sulphur Company, in particular by C. M. Cockrell, Chief Design Engineer, and C. O. Lee, Assistant Vice President and Senior Consultant. The writer served as Project Manager of the Grand Isle Mine in charge of the design and construction of the project.

Material for this paper was obtained from the engineering files and research reports of the Freeport Sulphur Company and from the following consultants' reports: "Oceanographic Study," Texas A. & M. Research Foundation; "Feasibility Study," Brown & Root Engineering Company; and "Soil Analysis," Eustis Engineering Company.

(This article was originally presented by Mr. McNamara as a paper at the ASCE New Orleans Convention, before the session of the Pipeline Division presided over by Fred C. Culpepper, chairman of the Division's Executive Committee.)

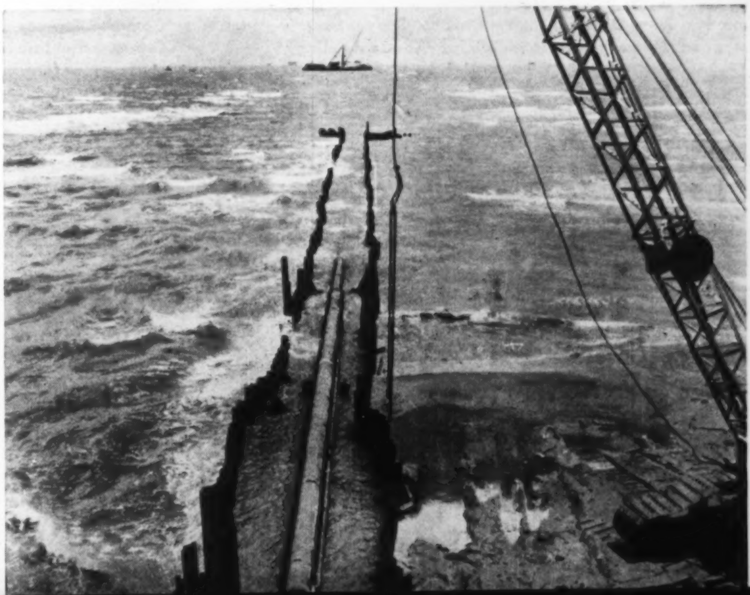


To withstand thermal stresses, special high-strength alloy steel is being used for the two inner lines of the pipeline that will carry the molten sulphur. Inner 6-in. O. D. line is for sulphur and 7⅝-in. O. D. line is for hot water. Hot-water line is insulated with 2¼-in. calcium silicate insulation and aluminum foil jacket, then encased in 14-in. bell-and-spigot 54.6-lb pipe wrapped with high-temperature coal tar and Fiberglas wrap.



Fabrication line 2,000 ft long is used to assemble pipeline that will carry hot sulphur. Sixteen 2,000-ft multiple sections were welded here. Buoy pipe and small lines were welded on an adjoining rack.

Two 250-ton diesel-powered winches mounted on a barge pulled this unique pipeline into the Gulf of Mexico and 7 miles out to man-made island.



New Orleans Host to ASCE Convention

New Orleans was a perfect host city to more than 1,200 ASCE members and their guests for the ASCE's midwinter Convention, held at the Jung Hotel, March 7-11. Some 100 technical papers were presented at 35 sessions of eleven Technical Divisions of the Society. A Local Section Conference, a Student Conference, and meetings of numerous committees advanced greatly the activities of the Society.

The ASCE Board of Direction, during its Convention meetings, announced selection of the St. Lawrence Project as the "outstanding civil engineering achievement" of the year, with an Honorable Mention for the Allegheny County Sewage Disposal Plant; designated E. Lawrence Chandler as first recipient of the Friedman Award for meritorious service to the profession; awarded the ASCE Research Fellowship for 1960-1961 to Ralph R. Rumer, Jr. These and other Board actions are detailed elsewhere in ASCE News.

Visiting engineers found great changes in New Orleans. Those coming by rail detrained at a new Union Passenger Terminal and traveled through a group of beautiful new federal, state, and city buildings through an area that was recently a slum. For air passengers a handsome barrel-roof terminal building, opened last November, offered every convenience. Travel in from the airport was over nearly completed expressways and interchanges and past a new bridge over the Mississippi. Motorists could cross the Lake Pontchartrain Causeway, said to be the longest bridge in the world.

Mayor de Lesseps S. Morrison of New Orleans, at a welcoming luncheon, described the $400 million in recent public improvements and $100 million annually in building permits under which the heart of the city is being changed. This is part of a well conceived plan to rejuvenate the downtown area. The plan is to preserve the old Spanish and French environment and yet meet the needs of the second busiest port in the U. S. and service the 45 multi-million-dollar new industries that have moved into the area. Foreign trade, said Mayor Morrison, has increased from a half-billion to two billion dollars a year in the past twelve years—a result of the cooperation of industry (through International House), the City, the Commissioners of the Port of New Orleans, and the State of Louisiana.

Water—Prime Convention Subject

Water—how to use and handle it most effectively—was a principal subject of the technical sessions. The Waterways and Harbors Division, frequently in joint session with the Construction Division, took the lead on river control, a subject of great importance in the Mid-South. Maj. Gen. William A. Carter, president of the Mississippi River Commission and Division Engineer of the Lower Mississippi Valley Division of the Corps of Engineers, was the keynote speaker in this field.

General Carter told a luncheon session that there are now 107 large dams on the Mississippi and its tributaries; 44 more are in or approaching the construction stage; and an additional 89 have been authorized for future construction. These dams will reduce flood height at Cairo, Ill., by 5½ ft and, conversely, will store water to increase low-water flow by 56,000 cfs. Some 1,870 miles of levees will protect the flood plains against 25 percent

Frank Marston, President of ASCE, was met at New Orleans Airport by Frank C. Fromherz, president of the Louisiana Section, and a snowman. The snowman was dug up by Mike Chenoweth, public relations director of ASCE, as a human interest story concerning Mr. Marston, who had been snowbound in New England enroute to the Convention. The idea got good TV coverage to publicize the Convention.

The Surveying and Mapping Division heard about swamps and overwater surveys. George Jones, with the California Co. of New Orleans, tells his fellow speakers about swamp surveys. At left is Earle J. Fennell, of U. S. Geologic Survey, at Washington; Coleman Kuhn, of New Orleans; Mr. Jones; Comdr. Clarence R. Reed, Coast and Geodetic Survey, New Orleans; and James M. Tuttle of Palmer and Baker, Inc., Mobile.

greater flow than that of the great 1927 flood. Straightening, by 16 cutoffs, has shortened the river 170 miles in the 560-mile stretch below Memphis.

The cost of work between Cairo and the Gulf since 1928 has totaled $1.1 billion. Flood damage prevented in the lower valley is estimated at $6 billion. Savings in moving 254 billion ton-miles of goods are estimated at $1.75 billion. Increased confidence in protection from flood has led to a billion-dollar expenditure for industrial construction between Baton Rouge and New Orleans in the past ten years.

The Old River Control Project was described at a Hydraulics Division session as "one of the really big jobs of flood control engineering undertaken in the United States," by Frederic M. Chatry, with the U. S. Army Engineer District at New Orleans. The basic purpose of the control project at Old River, which is a connecting channel for the Mississippi and Red Rivers, above Baton Rouge, is to prevent the adoption by the Mississippi River of the shorter route to the sea offered by the Atchafalaya River, and the possible by-passing of Baton Rouge and New Orleans.

Closure of Old River Critical

"The closure of Old River is a crucial feature of the project for flood control and improvement of the Lower Mississippi River," Col. George M. Cookson said at a Waterways and Harbors Division session. Colonel Cookson, District Engineer for the Corps of Engineers at New Orleans, outlined plans for making the closure in one low-water-high-water cycle in two stages.

Other speakers described important structures in the Old River control complex. Two of these papers appear in this issue.

In continuing the symposium on the Lower Mississippi River, J. Ira Boswell, chief of the Construction and Maintenance Branch of the U.S. Army Engineer District at Vicksburg, discussed the plant and methods used in the construction of revetments on the mighty river. He stated that the entire year's revetment construction is crowded into the low-water period between late July or August and November.

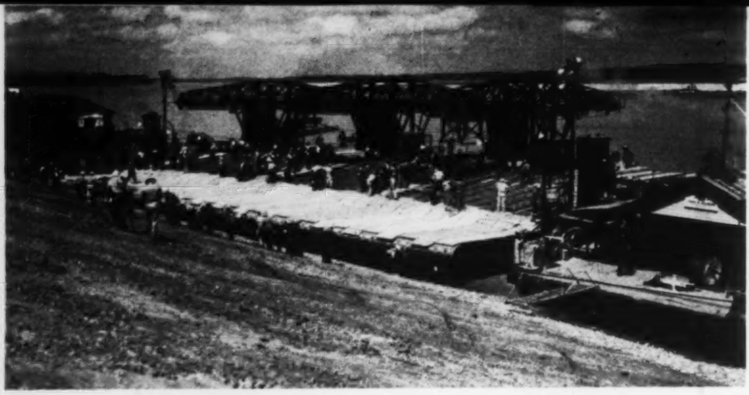
Initial operation on a typical Mississippi River revetment construction is bank preparation by dredges, draglines and bulldozers to smooth out the shore line. This highly mobile construction unit has some 225 employees who use 58 pieces of floating and land equipment in preparing for placing subaqueous concrete mattress. This is made up of units about 15 X 48 in. in plan and 4 in. thick cast with connecting wires into a 25-ft length. Corps of Engineers' plant is used to assemble this into units 140 ft wide so arranged that it can extend riverward 300 to 600 ft depending on the distance from the water's edge to the underwater toe of slope.

Such a revetment will resist normal forces for many years. Under abnormal attack it should retard bank recession sufficiently to retain desired alignment. Basically, said Mr. Boswell, the plan for revetment construction along 700 miles of river from Cairo to Baton Rouge has been to concentrate on the upper reaches and proceed downstream. In length the typical revetment may be 15,000 feet and cost $130 per linear foot of bank protected.

Prof. Walter Blessey of Tulane University (left) was technical program chairman; in center is Emmet Kerrigan, New Orleans attorney, who talked on legal matters affecting engineers; at right is Roy T. Sessums, of Freeport Sulphur Co., general chairman of the New Orleans Convention.

Extensive bank protection or channel stabilization works have been used on the streams tributary to the lower Mississippi River since the first structure was constructed in St. Louis in 1838. Harvill E. Weller, of the Channel Stabilization Section of the Mississippi River Commission, traced the evolution of protection to present-day methods. The first such struc-

A Conditions of Practice Session was devoted to a panel discussion of the Engineers Council for Professional Development accreditation of engineering curricula, procedures and policies. The panel, in usual order, consisted of Armour T. Granger, dean of engineering, University of Tennessee, Knoxville; Clarence H. Ax, consultant of St. Louis; Lee H. Johnson, Jr., dean of engineering, Tulane University, New Orleans; and Robert E. Stiemke, director of the School of Civil Engineering at Georgia Tech, who served as moderator.



One of three mattress-sinking plants operated by U. S. Engineer Department. A barge with flexible mats assembled into 25 X 4-ft units is brought up on the river side. Gantries set these on rollers on the deck. Wire is strung to hold sections together. The end is anchored to the bank and the barge backs away, as mat is fabricated and lowered. Bank protection on the Mississippi was the subject of several papers at the New Orleans Convention.

ture was built by young Lt. Robert E. Lee at St. Louis and consisted of about 3,800 ft of a brush and stone dike. The following years saw steel and wood jetties, brush and stone bulkheads at various points, rather than continuous revetment construction, steel pipe, tetrahedrons and steel fascine boxes. Currently the permeable pile dike is the most common type of dike in use. Also used are stone dikes and groins usually constructed of stone. Bank paving by cast stone or riprap is usually the most economical form of paving and is considered the most desirable from a performance standpoint. For subaqueous protection, the stone-ballasted lumber mattress is considered adequate in performance, is competitive in price, and does not require excessive labor.

A stabilization plan for the Arkansas River, part of a multi-purpose development of the river and its tributaries, was presented to a joint session of the Construction and Waterways and Harbors Divisions by E. B. Madden, of the U.S. Army Engineer District at Little Rock, Ark. The objective is to control the river by guiding or leading it rather than by attempting to resist it forcibly. The various types of bank stabilization and channel rectification structures being used to carry out the plan of development include the use of a cutoff channel to eliminate sharp bends; the use of revetments to stabilize the concave banks of bends; the use of dikes to close off a secondary channel, to control the direction of flow from one bend to another, and to "fair out" the concave bank of bends along a more desirable alignment.

Water inside New Orleans is as big a problem as that frequently hammering at the levees. Much of the city is 5 ft below Gulf level and all water including an annual 57 in. of rainfall must be pumped out. This operation, described by Electrical Engineer H. C. Swan and Mechanical Engineer D. D. Modianos, of the Sewerage and Water Board of New Orleans, utilizes pumps that will handle very large quantities. Water is collected separately for sewage, seepage, and storm runoff. Much of the seepage water is dirty and foul; it is moved across the city to Bayou Bienvenue so it does not contaminate the beaches of Lake Pontchartrain. Because of the early date of installations of the first pumping equipment much of it operates at 25 cycles with motors of 600 to 2,000 hp. Propeller pumps have been found most suitable for the large volume, 4 to 20-ft head, service required. New Orleans has several 14-ft screw pumps (152-in.-dia propeller, 1,000-cfs capacity) and many smaller ones.

Irrigation in Humid Areas

While disposing of surplus water on land and controlling it in the channels is a problem for some, irrigation in the lower Mississippi Valley is big business for others. How irrigation for rice production used 880,500 acre-ft of water on 463,437 acres of land was told in a paper by Austin Harrell, of the Rice Experiment Station of Louisiana State University, and M. D. Faulkner. Water comes from surface sources or wells; it can be purchased from commercial suppliers if desired.

Harold A. Scott, a consultant from Tampa, told a group of engineers attending an Irrigation and Drainage Division session that there is little doubt that irrigation is beneficial to crops in improving quality and quantity. There is some question, he said, as to the degree of the effect. Actually, it resolves into the factors of irrigation and crop production. The variables such as weather, soil fertility, and estimating time of application play a most important part in a successful operation. However, if the economics are favorable, that is, the cost of irrigation versus the increased revenue, there will be a demand for irrigation. In Florida, for example, beef cattle on irrigated pasture gained 810 lb while cattle on unirrigated land gained 294 lb. However, in Illinois the ratio was only 347 lb to 236 lb under similar conditions. In the latter case it was concluded that management practices would have to be improved for irrigation to pay.

Irrigation in the 31 Eastern states has increased from 600,000 acres in 1940 to over three million acres, Elmer W. Gain said in an Irrigation and Drainage Division paper. Mr. Gain, a drainage engineer of the U. S. Department of Agriculture stationed in Pennsylvania, commented that ground water is a diminishing source of supply as urban, industrial, and highway development take a million acres a year of the best land out of agriculture. Water will not be available for reasonable needs by the close of this century. An individual's rights to stream flow are often uncertain. Irrigation pumping usually is permitted as long as other users are not affected adversely. Now soil conservation districts can be formed under a federal Watershed Protection and Flood Prevention Act, Public Law 566. Policy requires that there be a favorable ratio of primary

The opening luncheon at the New Orleans Convention brought together, left to right, Frank Marston, President of ASCE; Mayor de Lesseps Morrison of New Orleans, the speaker; Lawrence A. Elsener, vice president of ASCE, Zone IV; I. W. Santry, president of the Texas Section; and Frank C. Fromherz, president of the Louisiana Section.

Pictured at start of an Irrigation and Drainage Division session are (seated, left to right) N. A. Christensen, director of engineering, Cornell University, and M. C. Boyer, of the Indiana Flood Control and Water Resources Commission. Standing are E. W. Gain, drainage engineer, U. S. Department of Agriculture; A. L. King, meteorologist, U. S. Weather Bureau, Memphis; and Paul H. Berg, U. S. Bureau of Reclamation, McCook, Nebr.

benefits to cost for federal participation. Loans can be obtained by local organizations for planning and carrying out needed improvements.

This greater interest in water has stimulated ASCE committee activity.

Proposed Water Policy

The Task Committee of the Irrigation and Drainage Division on Water Rights in States in the Humid Areas presented a proposed water policy for humid areas in a paper by its chairman, J. Irby Seay, Jr., consulting engineer of Memphis. The committee concluded that competent administrative and judicial personnel should be allowed to consider a case on its merits. It recommended that future water rights laws include provision for preliminary hearings on applications for water use before a special board, commission, or similar body, and that this body be provided with authority to regulate such water use with force and effect. The Committee commented that until a few years ago drainage and flood control were the great problems of most of the 31 humid area states. To completely reverse the thinking of a people will take time. Following is the proposed water policy for states in humid areas:

> "The objectives of a water policy are to promote conservation, protection, effective use, and maximum economic development of the natural water resources for all interests, riparian and nonriparian, in all areas, with due regard to private property rights and the investments involved.

"In summary, the Committee recommends that any proposed water rights legislation should:

"1. Exempt domestic water necessities of single-family units.
"2. Provide that the law be applied in an area only when the necessity of control can be shown for that area.
"3. Be capable of adjustment to meet changing requirements.
"4. Be capable of sound administration.
"5. Be flexible to allow for limited discretion by an Administrator to be exercised in the solution of water problems.
"6. Provide for judicial review with no new evidence presented on appeal.
"7. Provide for adequate public hearings.
"8. Allow the storage and use of available surplus waters for a definite time of withdrawal."

Engineers attending a session of the Waterways and Harbors Division heard a report presenting the major steps taken in the formulation of a Master Plan for the development of the Elizabeth Port Authority Piers. The plan as outlined by Guy F. Tozzoli, of the Port of New York Authority, is based in studies and analyses of those factors affecting efficient and economical land use such as area layout, potential commerce, traffic volumes, design standards, general and specialized cargo berth criteria, and other items necessary to the development of raw land into the port complex. It is estimated that the berths will handle 5,000,000 tons of general cargo per year, and the entire facility, to be constructed at a cost of approximately $150,000,000, will generate 8,000 jobs with an annual payroll of more than $40,000,000.

John S. Wilson presented construction aspects of the Elizabeth piers. The new terminal will cover 700 acres of tidal marsh and submerged land. The new channel, 9,000 ft long and from 600 to 800 ft wide and 35 ft deep, will have 7,700 ft of wharf on the south side and 5,300 ft of wharf on the north side. The dredging of the main channel and 1,800 ft of the channel on the Newark Bay front and the basic filling operation involved the hydraulic movement of some 13,000,000 cu yd of material from the new channels and its approaches.

Soil mechanics had to be combined with barge dock design to come up with

The Publications Committee of ASCE met in New Orleans. Seated, left to right are Director Wayne G. O'Harra, Phoenix; Director Bernhard Dornblatt, New Orleans; and Director Philip Rutledge of New York. Standing are Director Thomas M. Niles of Chicago and Editor Paul Parisi of ASCE Technical Publications.

an economical plan for a structure on the alluvial bank of the Atchafalaya River at Krotz Springs, La. F. Earl Hogan, of the Louisiana Department of Public Works, and Dr. Louis J. Capozzoli, Jr., of ETCO Engineers, collaborated on the design and the paper. By putting the wharf structure at right angles to the bank instead of parallel to it, the dock could better be extended to meet bank accretion and excavation could open up the other side of the dock for barges. Long H-piles gave a flexible structure and were loaded to 100 tons.

All Are Traffic Engineers

Grady Carlisle, assistant to the director of the Louisiana Department of Highways, Baton Rouge, in a paper devoted to state cooperation in planning Louisiana urban facilities, commented that the accelerated apportionment of federal funds for Interstate Highway construction has generated interest from sources that have never before been concerned with highway programs. These curbstone engineers, he stated, can cite all the reasons why a proposed highway location is wrong, all without benefit of traffic information and economic data. The changes are often so dramatic in their effect—very profitable to some, adverse to others—that pressures are inevitable from every walk of life. To allay fears, both real and imagined, it is necessary to make the greatest effort towards informing the public. In his talk Mr. Carlisle told of legislation that requires all municipalities of over 5,000 population in Louisiana to develop and adopt a major street plan, subject to approval by the Board of Highways.

Improperly placed lights can completely obliterate signs at night, Hubert A. Henry, design engineer for the Texas Highway Department, told engineers attending a Highway Division session. The design of each intersection should be considered for the specific problem, based on developing situations requiring the driver to make one decision at a time. Properly placed lights and signs will help him make his decision quickly and accurately.

J. C. Barrett, of the Mississippi State Highway Department, explained how his state uses photogrammetry and electronic computers in their highway work. Probably the greatest advantage of using the computor in highway work will accrue from analyzing many alternate designs. This is being done in structural design and is now possible in earthwork design. With the advent of photogrammetric topographic mapping and electronic computation of earthwork quantities, it is now economical and fast to examine thoroughly any trial line of roadway that appears promising.

A Challenge

Real competition for engineered construction was asked by R. M. DuBois, president of the Freyssinet Co. Inc., of New York, in a challenge to a joint Structural and Construction Division session. Pointing out that for the Champlain Bridge at Montreal prices ranged from $27 million down to $8 million for a structure to meet the same basic design criteria, Mr. DuBois deplored the practice of soliciting bids only on already detailed projects. He commented that this does not leave a prospective builder any room for exercising ingenuity so competition is reduced to determining how "hungry" other contractors are for work. The Champlain Bridge is to be built to a contractor-developed prestressed concrete design for the National Harbors Board, a Canadian Government agency. It will carry a six-lane highway 10,400 ft over the St. Lawrence, rising to a height of 90 ft at the navigation channel. There was no discussion of the merits of contractor-engineer-prepared designs, a common practice in Europe.

Special designs and special equipment for a precast, post-tensioned bridge across Lake Oneida near Syracuse, N. Y., were described by Eric C. Molke, of Summers, Munninger & Molke, Albany. It was necessary to keep a 230-ft-wide ship channel with 20-ft vertical clearance open during the entire construction. High-capacity lifting equipment was not available on the lake. Each of two separate parallel structures carrying three lanes of traffic in one direction has six 146-ft cantilever girders projecting 72 ft beyond the piers. Each weighs 240 tons. These were precast and rolled into position. Then five 231-ft-long girders (weight 230 tons each) were successively winched out on a barge and pulled up by jacks to a position between pairs of cantilever girders. A concrete deck was then placed over the girders to make the longest prestressed concrete span in the Americas.

More data on change of camber and length of the larger prestressed concrete members were asked by Morris Schupack, of Schupack and Zollman, consultants of Stamford, Conn. Speaking primarily on cast-in-place prestressed bridges, with which he has had considerable experience, he commented that: (1) forms can be straight sided and simple for T-beam bridges; (2) falsework can be rather flexible and transverse construction joints eliminated if a proper retarding admixture is used and if the segment to be concreted can be completed in 8 to 12 hours; (3) casting-in-place permits working on the substructure and superstructure at the same time with the same equipment; (4) one-end stressing of the wires has been successfully done up to 154-ft spans and can be extended, but some friction loss must be planned for.

Deflections for longer cast-in-place spans can be predicted within ¾ in. Besides camber variations, the longitudinal shortening is a function of the volume change characteristic of prestressed concrete. The amount of such shortening has generally been estimated higher than has been found to occur in the field, hence the search for more data on relation of design expectation to measured change.

Engineers attending a Structural Division session heard a paper by J. C. Brough and B. H. Stephens, in which it was stated that to obtain longer span construction, the shape of the structure becomes a dominant factor. The folded plate shape of roof structures has come into wide usage because of its low cost of construction for long spans, high-load-carrying capacity, rigidity, and its esthetic interest. Selection of concrete for the shell material furnishes a high degree of fire resistivity, ease of molding to the desired alignment and profile, permanence, low construction and maintenance costs.

Mile-High Tower

A simplified chart for determining the preliminary design of guyed towers using only familiar concepts of structural mechanics, was presented to a joint session of the Power and Structural Divisions. In describing the value of the chart, Robert S. Rowe, chairman of the Civil Engineering Department at Duke University, stated that it shows immediately, without elaborate computation, possible dimensions for various tower components. Mr. Rowe explored the possibility of a mile-high tower. The pre-design chart indicates that leg diameters would vary from 8 to 15 in. at the base. Because of such large leg diameters heavy forgings would be necessary. The length of such members would be limited, and hence the first difficulty in the tower design is encountered. Furthermore, the guys themselves present considerable difficulties. Usual assumptions that have negligible effect upon a small tower have considerable effect on taller towers. In erection, extra heavy hoisting equipment would be needed for the tower legs; a large area would be needed for the guy cables to be stretched out on the ground prior to hanging; and climatic conditions would have considerable effect on visibility and erecting operations. Perhaps there are other problems that make the erection of a mile-high tower questionable. Can it be done?

The same session heard a paper on the design of self-supported steel transmission towers by Richard N. Bergstrom, J. R. Arena, and J. M. Kramer. The paper contained a discussion on the design criteria for self-supported transmission towers; the authors expressed a hope that this discussion would result in the improvement of existing codes. Items to be considered in the design of economic transmission lines include:

1. Selection of design loading conditions comparable with the anticipated loads rather than provision for every remote contingency,
2. Extensive studies on various configurations to achieve the optimum strength with the least material,
3. And the incorporation of high-strength steel in the design at advantageous points.

Furthermore, there should be willingness to consider a rectangular tower cross-section with its increased complexities. Careful checking and rechecking of members to insure the selection of minimum sizes or use of a computer program to select them automatically is another important factor in the design of an economical transmission line.

Helicopters can be used for the erection of towers in inaccessible areas at a saving of up to 50 percent, Frederick R. Payne, of the Southern California Edison Co., said. Up to 15 poles can be set per hour. This paper, with time and cost data, will appear in an early issue of Civil Engineering.

Pipeliners Have Problems

The Pipeline Division, through its Committee on Installation, has a Task Committee on Flotation Studies. Reporting for this committee, Raymond H. Crowe, of the Transcontinental Gas Pipeline Corp., asked the assistance of all engineers on problems, such as (1) a man-made lake will cover 5 miles of existing 30- and 36-in. pipe in a trench. To provide a specific gravity of 115 by installation of 1,300 weights will cost $300,000. Is it necessary? (2) Mr. Crowe's firm spent over $3,000,000 for weights on 755 miles of gas lines, much of it in Louisiana swamps. How much was really necessary to prevent flotation? (3) Should pipeline laid offshore have extra weight to resist currents or wave action? The Committee is anxious to have comments.

A new type prefabricated aerial pipeline bridge was the subject of a paper by Weldon F. Appelt, of the Clear Span Engineering Co., Houston, at a session of the Pipeline Division. Recently five such bridges were erected across streams on the Houston Texas Gas and Oil Corporation system, which runs from Louisiana to Florida. Each of the new bridges spans a river with a 24-in. pipeline, yet despite the sizable load, spans were constructed in just a few working days and actual erection took only an hour or so.

These bridges, which bring new economies to pipelines, are shop made then shipped to the job site for erection. Pipe for the crossing is welded up on shore, attached to a cable system. Meanwhile, the towers which come to the job in 40-ft sections are welded together face down and pinned to their foundations. The pipe and cable system is floated across the river, attached to the tops of the two towers. When the two inverted "Y"-shaped towers are pulled up, in an operation that takes about an hour, the entire span—pipe, wire rope system—rises into permanent position above the water.

How a microwave system was used to transmit control signals 45 miles to an inaccessible compressor station was told by William E. Matthews, of the Southern National Gas Co. Operating personnel at a distant station are able to start, stop, and control the speed of each engine at the isolated plant. They can also call for any desired selective telemetering of pressures, temperatures, and engine speeds, an emergency shutdown and the like. It was possible to eliminate the problems associated with having personnel living on an isolated platform. Much valuable experience was gained from the use of remote control, and there was a substantial cost saving.

D. C. Simpson, of the Shell Pipeline Corp., told a Pipeline Division session about the interesting $11,000,000 Delta Pipeline extending 100 miles from oil fields in the Lower Mississippi River Delta to the Norco Refinery. The system provides (1) transportation for crude oil at a substantially lower cost than barge costs and (2) continuous, safe, and reliable delivery of crude oil to the New Orleans area unaffected by inclement climatic conditions. Pipe varies in size from 20 in. down to 6 in. with about a $\frac{1}{4}$-in. wall. The 6- and 12-in. pipe was shop coated with $\frac{1}{2}$-in. Somastic protection, the 16-in. has $\frac{9}{16}$-in. cover, and the 20-in., $\frac{5}{8}$-in. protection. As a test for future use some of the 8-in. pipe has a $\frac{4}{32}$-in. asphalt enamel, while other sections have $\frac{4}{32}$ in. of coal tar enamel cover. All pipe is in a backfilled ditch, an innovation in this area where pipe generally is in a canal or open ditch.

Automatic Power Station

Early in 1961 the first unit of the 230,000-kw capacity Little Gypsy Power Plant in Louisiana will be placed in operation. Engineers attending a Power Division session heard George S. Bingham, principal concrete hydraulic engineer with Ebasco Services, Inc., describe the civil engineering aspects of the new plant which is located on the Mississippi River about 25 miles north of New Orleans. Little Gypsy will be the first fully automatic steam electric station in the world, capable of starting, synchronizing, reaching full load, and controlling itself during operation, all by pushing one button. Power Division engineers enjoyed a trip to this plant as a feature of the Convention.

Research and Development

The increasing interest of ASCE in research resulted in papers covering varied fields. For example, the use of prestressed concrete has developed to the point where detailed information concerning its physical characteristics is urgently needed by engineers.

Engineers attending a session of the Structural Division heard a paper by

Pipeline Division session brings together (left to right) Donald E. Adams, Pipeline Division secretary; Glenn P. Thompson, Tennessee Gas Transmission Co.; William E. Matthews, Southern Natural Gas Co.; E. J. McNamara, Freeport Sulphur Co.; and Fred Culpepper, chairman, Executive Committee, Pipeline Division.

Women's activities at New Orleans were headed by Mrs. Frank C. Fromherz, at left, talking with Mrs. Charles Molineaux of New York and Mrs. Lawrence A. Elsener of San Francisco.

Prof. M. J. Gutzwiller, of Purdue University, and F. E. Musleh in which data on freeze and thaw tests on 48 specimens representing strength levels of 5,000 psi and 3,000 psi were reported. Some of the beams with a 5,000-psi strength were post-tensioned throughout the test. Significant improvement in the durability was found to result from post-tensioning of the beams. Post-tensioned concrete specimens made of a rich mix showed better durability than unstressed concrete made of the same mix and also better durability than unstressed concrete made of a leaner mix.

Hubert Woods, director of research for the Portland Cement Association, told about new facilities at Skokie, Ill., for study of fire resistance of prestressed concrete structural members. Mr. Woods commented that much significant work on this has been done in Europe, but code authorities here are unaware of it or seem unwilling to accept it. To provide acceptable information PCA has constructed a new Fire Research Center. One furnace has a firebox 40 ft long and 6 ft 4 in. wide so equipped that beams up to 60 ft long can be tested with live load applied by hydraulic jacks. The gas-fired furnace can be programmed to follow various time-temperature curves. A 43-ft 6-in. beam was fired for 4½ hours, with temperature reaching 2,050 deg F. Deflection under 92,000-lb design load was 6.35 in. with recovery to 5.25 in. after 24 hours. Only a small amount of concrete spalled off the reinforcing. The beam was later tested to destruction, failing at 117,700 lb by crushing of concrete in the upper flange.

Research Needs a Program

In a challenging talk at the Research Awards Luncheon Morrough P. O'Brien, dean emeritus of the College of Engineering at the University of California, Berkeley, said that "civil engineering science is the body of facts and relationships basic to the practice of civil engineering. Research in civil engineering is the search for these basic facts and relationships—by laboratory experiment, by pencil and paper analysis, by observation of full-scale systems, or by whatever means are appropriate. It is of the utmost importance to the profession and to society that this quest for improvement be actively pursued.

"From the developing broad scientific base, engineering science should now seek to account for the macroscopic properties of the older materials—concrete, steel, timber—and of the newer materials—alloys, plastics, adhesives and composites—and to provide the practicing engineer with reliable data on the other properties affecting design. It is time for a new look in the field of civil engineering materials. . . .

"Regarding the means of carrying on research in civil engineering . . . I am convinced that the faculty and graduate students of the engineering colleges are generally best qualified . . . It will be necessary for the civil engineering faculties to formulate broad and imaginative plans which will bring financial support and induce the collaboration of specialists in other fields. Success in this respect will attract competent graduate students. The money is available. The urgent need is for imaginative programs."

Common Sense Needed

Former ASCE President Mason G. Lockwood, consulting engineer of Houston, Tex., told 150 students of civil engineering at a student-faculty banquet held at the Tulane University Student Center, that common sense was as much a requirement of engineering as any other quality.

Mr. Lockwood was the featured speaker on the student program of the Society Convention in New Orleans. He said, "If you are endowed with common sense—another name for which is judgment—there is likely to be a good place for you in engineering."

"But," he added, "if in the apportionment of talents among the human race, you were left without this one of common sense, then the quicker you abandon engineering, the better."

Mr. Lockwood said that the three essentials for an engineering education are vocabulary, logic, and imagination. But he added that while these are requisites, they are not enough.

"We talk a lot about there being no substitute for experience. We ought to bracket with experience common sense as something for which there is no substitute.

"It is my conclusion that, reduced to its barest essentials, the ultimate aim of good engineering is the achievement of benefits more valuable than the cost of producing them.

"What separates the men from the boys in engineering is the ability to reasonably foresee, describe, and evaluate both the benefits and the costs."

Other student activities included discussion of Chapter programs, attendance at Convention technical sessions, and inspection trips. Another feature was a paper competition among the Student Chapter groups in Louisiana. The 150 students in civil engineering came from 15 colleges and universities in Louisiana and adjoining states. Included in the group were 33 students from the University of Oklahoma and Oklahoma State University. The Oklahoma City Branch of the Oklahoma Section raised $1,600 to pay most of the group's expenses. The trip was sponsored through the efforts of ASCE Director W. W. Baker, assisted by Neal McCaleb and S. F. Baker. The group was accommodated overnight by the Dickey Clay Pipe Company at Texarkana and by the Waterways Experiment Station at Vicksburg.

Fun in New Orleans

Despite a popular concept of reduced activity in New Orleans after Mardi Gras the city was wide open for visitors; and the local ASCE committees provided interesting and varied activities for all the guests. The Ice Breaker Party on Monday evening was attended by most of the 800 then registered. The reception and dance on Wednesday featured a band that plays for several of the Krewe balls during New Orleans's carnival weeks. A floor show at the dinner was sponsored by local engineering organizations. The New Orleans Dock Board provided a tour of the harbor daily. The ladies were entertained by a committee headed by Mrs. Frank C. Fromherz wife of the president of the Louisiana Section. Trips included the Vieux Carré and the fabulous Garden District.

Credit Where It Is Due

The technical program, one of the finest in recent Convention history, was prepared under a Technical Program Committee, headed by Walter Blessey. The many other committees functioned under General Convention Chairman Roy T. Sessums. Frank C. Fromherz is president of the Louisiana Section, which was host to the Convention. As ASCE Director for District 15, Bernhard Dornblatt was also on the job. To these and the many other hard-working Louisiana Section members, the Society gives hearty thanks for an interesting and enjoyable Convention.

Board of Direction Meets in New Orleans

A number of important official actions were taken by the Board of Direction at its meetings during the New Orleans Convention. Actions of special interest are briefed here.

1960 Civil Engineering Achievement

The St. Lawrence Project was designated winner of the Outstanding Civil Engineering Achievement Award for 1960, with a special Honorable Mention to the Allegheny County Sewage Disposal System. Details will be found on page 76.

E. L. Chandler Honored

On recommendation of the Executive Committee, the Board approved a resilution honoring E. Lawrence Chandler, who is retiring this spring from his post as Assistant Secretary after many years in the service of the Society.

The resolution reads: "The Board of Direction of the American Society of Civil Engineers—recognizing that the Society's total accomplishments are the result of tireless, intelligent efforts of dedicated individuals within its membership—hereby expresses its deep debt of gratitude to E. Lawrence Chandler who first entered the ranks of professional men as a Junior in the Society in 1909. For a full half-century, as practicing engineer, administrator, loyal member of the Society and staff officer, he has contributed stability of judgment, friendliness and wisdom."

With this expression of appreciation on his retirement the Board of Direction extends to Mr. Chandler its best wishes for good health and happiness in the years ahead.

New ASCE Awards Established

On recommendation of the Committee on Society Honors, the Board established rules for two new ASCE awards. These are the ASCE Professional Recognition Award and the Theodore Von Kármán Medal, which is intended to advance the science and profession of engineering in the field of engineering mechanics. Both awards are described elsewhere in ASCE News.

On unanimous recommendation of the Conditions of Practice Executive Committee, it was voted to designate E. Lawrence Chandler the first recipient of the ASCE Professional Recognition Award, with provision to be made for presenting the award at the Reno Convention this June.

Research Fellowship Awarded

On recommendation of the Committee on Fellowships, Scholarships, Grants and Bequests, the Board granted the 1960-1961 ASCE Research Fellowship to Ralph R. Rumer, Jr., for analytical and experimental investigation of diffusion and gravitational convection in liquids of different density in porous media. Mr. Rumer will carry out his research in the hydrodynamics laboratory at Massachusetts Institute of Technology under a $5,000 grant.

National Water Policy

Concerning national water policy, it was voted that ASCE representations to Congress and elsewhere on matters of national water policy shall continue to be made through the Engineers Joint Council. The liaison Committee on EJC National Water Policy shall continue to be the source of development of ASCE policy in this field. The Society expects to support the statement made to the Senate Select Committee on National Water Resources through Engineers Joint Council before July 15, with the proviso that it conform to the "1957 Restatement of Principles of a Sound National Water Policy." ASCE has offered to assist Engineers Joint Council in providing for appropriate consideration and action on the report of the Senate Select Committee on National Water Resources.

Push UEC Fund Drive

The Board unanimously agreed to make every possible effort to fill the ASCE quota for the United Engineering Center fund by the time of the next Convention—at Reno, Nev., June 20-24. It was emphatically stated, however, that the drive will continue as long as necessary to reach the $800,000 goal set for ASCE.

Student Chapters

On recommendation of the Committee on Conditions of Practice, it was voted to authorize the establishment of Student Chapters at San José State College, San José, Calif., and Youngstown University, Youngstown, Ohio.

The rules of policy and procedure will be amended to provide that there shall be only one officially appointed Faculty Adviser, Contact Member, and Associate Contact Member for each Student Chapter.

Associate Member Forums

The Board authorized changing the designation "Younger Member Forum" to "Associate Member Forum."

Other Board Actions

Reporting for the **Committee on Districts and Zones,** Chairman Knapp noted that it is studying responses from the Local Sections on the alternate plans originally proposed. A recommendation will be developed for presentation to the Board in June.

The Board approved action of the **Committee on Membership Qualification** on 47 "difficult" cases.

Admission of recent graduates to **Associate Membership** in ASCE will be speeded by a new procedure that reduces the time required for Board action.

Professional Conduct Action

Under provision of the Constitution and Bylaws, the Board of Direction acted to expel Edward A. Elevatorski from membership in the Society. Mr. Elevatorski was found to have made false statements regarding his educational status in his application for membership in the Society.

Top Engineers in Government

A study of personnel for top **administrative positions** in the **Federal Government** shows that engineers now fill most of those for which such a background might be especially suited. Since these positions are more administrative than engineering and are political appointments, it seems best to make no direct suggestions, as a Society action, to promote filling such jobs. However, when a position is open, early effort is suggested to assure that the qualifications of suitable engineers are brought to the attention of the proper parties at the time appointments are first being considered.

New Appointees

Appointments made by the Board were: William H. Wisely as **United Engineering Trustee** director for a four-year term to succeed George W. Burpee; George W. Burpee and Waldo G. Bowman as representative and alternate, respectively, to serve six-year terms on the **Hoover Medal Board of Award;** and Thomas M. Niles reappointed for a two-year term as ASCE representative on the **Washington Award Commission.**

(More ASCE News—pages 76 & 83)

Steel joists lower unit costs for a supermarket

JAMES R. CASS, Jr., M. ASCE, Engineer, Fay, Spofford and Thorndike, Inc., Boston, Mass.

Use of high-strength steel joists for roof framing in a large supermarket for Tedeschi Realty Corporation in Brockton, Mass., accounted for significant cost savings for structural steel and permitted more advantageous design of the roof and secondary framing.

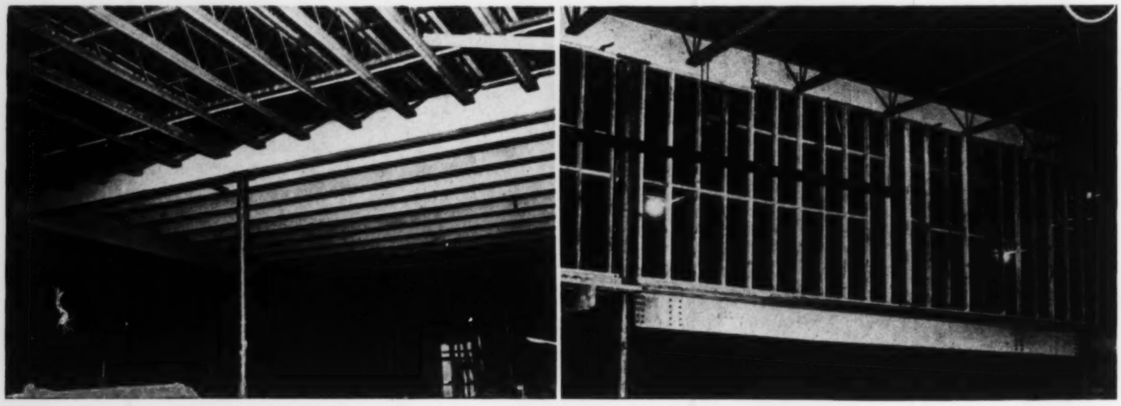
Several facets—most in fact—of the design criteria for the building were inflexible. The structure, engineered by Fay, Spofford and Thorndike, Inc., of Boston, had to be 175 by 230 ft in plan. Column locations, interior components and the building layout were set by client requirements before the detailed design was started. But the framing system for the roof offered the engineers their first opportunity to better, or at least control, the construction costs previously estimated.

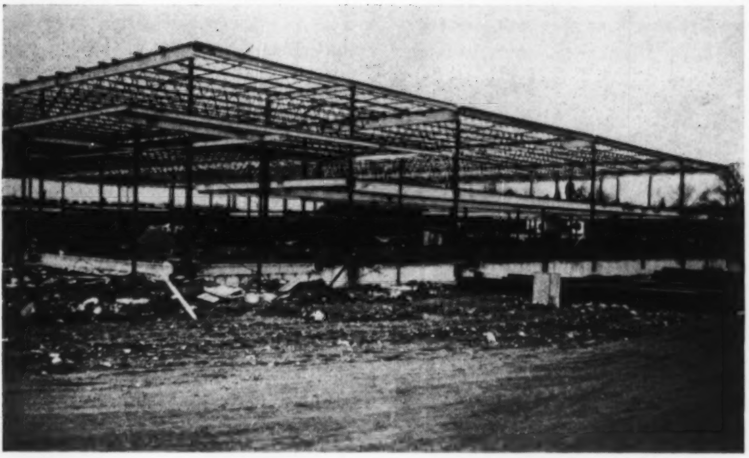
Three systems of open-web steel joists were deemed acceptable—one using standard, one long-span, and one high-strength joists. Each was carefully scrutinized and its relative merits examined. In the end, a compilation of tonnage, of empirical data, and of prevailing steel prices favored the high-strength joist, even though the cost per pound was higher. The higher allowable stress, the increased spacing, and the lighter supporting frame required, proved to be the principal reasons.

In comparison, the total cost of these joists ran about 60 percent of that estimated for long-span joists and about 80 percent of that for standard joists. But these conclusions were conditional, depending primarily on the design of a roof system to correspond to the wider spans without resorting to heavier roof members and thereby erasing a lot of the savings.

Four roof systems, all with a five-ply covering of tar and gravel, were considered: (1) a metal deck, (2) a 2-in. layer of poured gypsum on a 1-in.-thick insulating board, (3) wood plank, and (4) precast concrete roof-deck units. Obviously some were unacceptable if high-strength joists were to be

At left, beams supporting one section of a mezzanine floor are raised 12 in. to provide head room under the mezzanine and to support mechanical equipment installed above on a poured slab. Beams are 16WF36 in this section. Steeltex floor lath that supported the mezzanine-floor concrete is visible above the joists. At right, center span is seen at roof level after the roof deck has been installed. The cantilevered portion of the beams between the pipe columns and the splices is designed to equalize bending moments and permit the use of a smaller member for the center span.





High-strength steel members have been assembled to provide framing for new Tedeschi supermarket in Brockton, Mass. Significant savings resulted from using the longer spans made possible by the high-strength characteristics of the steel joists.

used; span limitations ruled out some as did fireproofing requirements and insurance rates. It became evident that a metal deck was to be preferred for most of the roof even though the unit costs for the four types varied only 5 percent.

Economy continuing to be the keynote, the main framing members were designed as simple-span beams cantilevered beyond the columns, with other beams suspended between the cantilever ends. Thus the positive moments were reduced to equal the negative moments, and though the spans were of different lengths, the steelwork was standardized considerably.

In terms of economics, the design permitted a saving of about $3,500 in the structural steel contract. Also, the guaranteed five-week delivery date turned out to be of measurable importance as the steel was ordered and received shortly before the steel strike began.

More and better engineers needed

For the second consecutive year, enrollment in America's accredited engineering colleges has dropped. This fall 240,063 students registered in engineering. Last year there were 249,950, and in the fall of 1957 the total was 257,777.

Because of high freshman enrollments in the mid-1950's, the number of engineering graduates currently continues to rise. In the year ending in June 1959, 41,132 degrees were given in various fields of engineering. However, on the basis of recent enrollments, there will be fewer engineering graduates in the next year or two.

This is the opinion of the American Society of Engineering Education, which has just released its annual survey of enrollments in schools having accredited engineering curricula. The figures, compiled by the U. S. Office of Education, come from 154 engineering schools in the United States and are assembled each year under a joint ASEE–Office of Education project. They cover all engineering colleges with one or more engineering curricula accredited by the Engineers' Council for Professional Development.

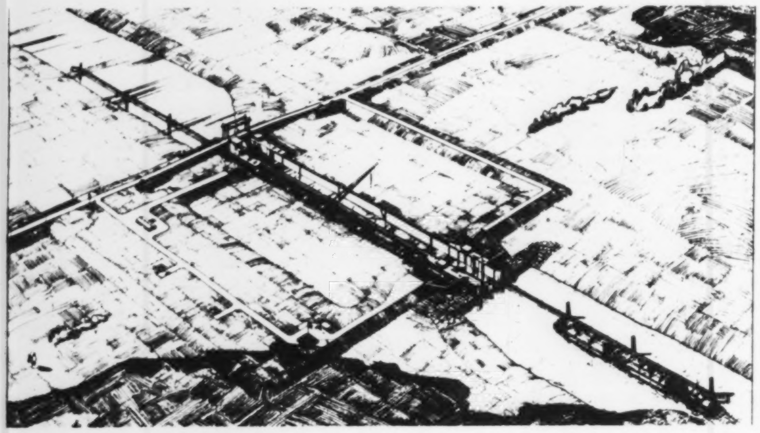
Total engineering enrollment in the fall of 1959 was down 4 percent from 1958 and 6.9 percent from 1957, according to the survey. These decreases in engineering enrollment came at a time when total college enrollments were rising by 10.9 percent during the two-year period. In 1959 engineering students accounted for only 7.1 percent of all college students, compared with the high of 8.4 percent in 1957.

B. R. Teare, Jr., president of ASEE, states, "This continued decrease in enrollment, and particularly the decrease in freshman enrollment, is a matter of great concern to all of us. The studies of the Engineering Manpower Commission indicate not only that the demand for engineers is increasing, but also that it is expected to accelerate. Our ability to expand the production of consumer goods to satisfy the requirements of our multiplying population depends upon a large and increasing supply of well educated engineers. In addition, they are needed for our space exploration program and the development of ballistic missiles, and of other weapons of defense. The demand from all these sources for more engineers will increase in future years, and will have to be met by the students now enrolled in engineering schools and those who will enroll in the next few years. If the industrial growth of the country and the defense programs are not to be impaired, the trend of the past two years must be reversed." Dean Teare also suggested that every time there is a business setback, "the press and the general public should not cry 'wolf' and thus discourage students from undertaking the study of engineering."

Engineering enrollments for advanced degrees continued to show increases in the fall of 1959. Even here, however, the rate of growth is decreasing, according to the ASEE–Office of Education figures. Of 34,731 graduate students this fall, 28,734 were registered for the master's degree, 357 for professional degrees, and 5,640 for doctor's degrees. This represents a 6 percent increase in master's and 18.4 percent increase in doctor's registrants over the previous year.

Dean Teare warns that, "If undergraduate numbers continue to decrease, it is obvious that the urgently needed growth of graduate enrollment cannot be expected." The demand for quality is even greater than the demand for numbers, in industry, in government, and especially in educational institutions. The supply of qualified young men to strengthen present faculties is still seen as the greatest problem in engineering education.

Old River Lock and levees are seen in perspective sketch as they will look when completed.



OLD RIVER LOCK unusual features

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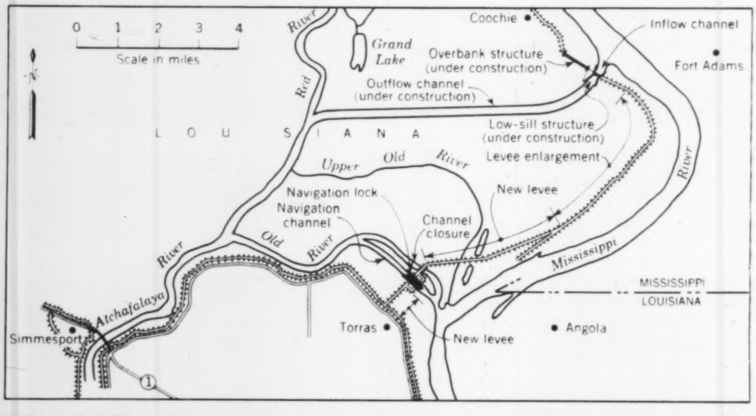

0 1 2 3 4
Scale in miles
N
River
Red
Grand Lake
Coochie
Overbank structure (under construction)
Outflow channel (under construction)
Inflow channel
Fort Adams
L O U I S I A N A
Low-sill structure (under construction)
Upper Old River
Levee enlargement
River
Navigation lock
Navigation channel
New levee
Channel closure
Old River
River
Mississippi
MISSISSIPPI
LOUISIANA
Atchafalaya
Simmesport
Torras
New levee
Angola
1

FIG. 1. Old River Lock and closure dam of rock and earthfill prevent flow of Mississippi from being diverted down the Atchafalaya, except under controlled conditions.

The Old River Navigation Lock, on the Lower Mississippi River, has five unusual features that make it of exceptional interest to designers and constructors. Water, both upstream and down, may vary as much as 63 ft from flood flow to low flow with a differential head from 2 ft to 40 ft. The underlying soil is a fine sand—good for bearing when confined but difficult to penetrate with piling. The lock is isolated from heavy equipment and so requires its own equipment for heavy repairs. And a state highway is supported over the lock, which is being built for the Corps of Engineers.

The Old River Navigation Lock is a major element in the project for the control of Old River, a natural waterway connecting the Mississippi River with the Atchafalaya River about 50 miles northwest of Baton Rouge, La. Changing hydraulic gradients and scouring of this natural channel, plus the fact that the Atchafalaya route to the Gulf of Mexico is some 180 miles shorter than the Mississippi route, has caused this connection between the rivers to take an increasing part of the flow of the Mississippi with each high-water stage. During the last major flood on the Mississippi, 40 percent of its flow was diverted into the Atchafalaya via Old River. This indicated that unless the flow through Old River was controlled, the entire flow of the Mississippi might, at some future time, be diverted down the Atchafalaya, depriving the very important industrial areas downstream on the Mississippi—and the cities of Baton Rouge and New Orleans—of their supply of fresh water.

After an extensive study by the Corps of Engineers, a project was developed that includes the following major elements:

1. Closure of the natural channel of Old River by means of a rock and earthfill dam.
2. Construction of a navigation lock near the dam with the dredging of short connecting channels from the lock to the existing natural channel.
3. Construction of a low-sill structure with gates permitting control of the flow at any stage of the Mississippi River.
4. Construction of an overbank structure permitting overflow of water from the Mississippi into the Atchafalaya at high stages of the Mississippi.

The project was authorized in 1954. The lock site, and the relation of Old River to the Mississippi, the Red and the Atchafalaya, as well as the locations of the low-sill structure and overbank structure are shown in Fig. 1. In the following discussion the end of the lock connecting to the Mississippi will be referred to as the "river," or upstream end, and that connecting to Old River through a dredged channel will be called the "canal," or downstream end.

Because of the practical necessity of having a means of control available before the closure of Old River, and for construction convenience, the elements are being constructed in the reverse order from that in which they are listed above. The overbank structure and low-sill structure are now finished, and the navigation lock is under construction. The closure dam is planned to be the final element completed. The lock chamber has a width of 75 ft and a length of 1,200 ft and a sill elevation of minus 11.0, referred to mean sea level.

The first unusual feature affecting the design of the lock structure at Old River is the extreme fluctuation in upstream and downstream river stages. A review of river hydrographs, plus study of conditions expected to prevail after currently planned improvements are completed, indicated that a design stage of El. 65.0 at the Mississippi River end of the lock, and of El. 63.0 in the Old River backwater at the canal end of the lock, should be used. Low water is at El. 2.0, and the lock sill is at El. − 11.0 msl to insure the desired draft at extreme low water. The top of the lock walls is established at El. 67.0; thus the walls of the lock chamber are 78 ft high. With a lock width of 75 ft, the height-to-width ratio is almost unity.

As will be noted from the general plan, Old River connects the Mississippi with the Red River and the Atchafalaya River and is therefore affected by the stages in each of these streams. The possible combinations of river stages were the source of extensive study by the Corps of Engineers, and it was determined that it would not be necessary to design Old River Lock for reverse pressure—that is, the downstream water level would never exceed the upstream level. However, the combinations of conditions resulting from fluctuations in the various river stages produce extreme variations in hydraulic conditions at the lock site. A series of such conditions was investigated for the design of the lock structure, gates and valves. The principal corresponding stages of river and canal controlling the design are:

River Stages, msl	Canal Stages, msl
El. 65	El. 35
El. 65	El. 25
El. 60	El. 25
El. 52	El. 15
El. 34	El. 2

The maximum operating condition provided for in the design is a differential head of 37 ft. The river stage of El. 65 with canal stage of El. 25 is a special case for which only a stability check was made.

The area surrounding the lock is subject to flooding by backwater and therefore, in considering the stability of the lock structure, it was necessary to consider the ground-water level and the condition of saturation of the backfill against the lock walls. It was necessary also to check the structure very carefully against flotation during dewatering operations for maintenance, and to determine to what extent the lock could be dewatered for repair of gate damage during high water.

Uplift critical

Because of the possibility of high differential heads across the lock, the development of uplift pressures on the structure had to be carefully considered. As will be discussed later, the lock is founded on a very porous sand and flow-net analysis indicated the probable development of high ground-water pressures beneath the upstream sections of the lock structure. Estimates were made of the probable variation in such pressures from the upstream to the downstream end of the lock. Means were provided for partially controlling these pressures and resisting the remaining pressure.

The second unusual feature influencing the design is the nature of the soils encountered at the site. The lock is located in an alluvial deposit of the river valley, there being no bedrock for a depth of several hundred feet. The stratum underlying the lock at the general elevation of the bottom of the foundations is a fine sand with a bearing capacity, when confined, of 12,000 psf, computed by Terzaghi's method of analysis. This bearing value is ample for most foundation work, but such a stratum provides excellent foundation support only so long as it is confined and undisturbed. With the frequent fluctuations in water level occurring in the operation of the navigation lock, and consequent danger of pumping action, it is extremely important to insure against erosion or flow of the foundation material. As a further consideration in foundation design, it is difficult and expensive to drive piling into such sand even though it offers good support.

The presence of this fine sand also caused concern regarding possible seepage beneath and around the lock. After considerable study, it was decided to limit this seepage to some extent and to control hydrostatic pressure. This was done by constructing a cutoff wall of sheetpiling at the river end of the lock and by installing impervious clay blankets in the backfill at the river end and on each side of the lock.

The lock structure is some 1,544 ft long overall and is designed to be constructed of twenty-three monoliths, which vary in length from 60 to 117.5 ft. At each end of the lock there are approach bays, gate bays, and valve bays, each constructed as a separate monolith.

Filling and emptying the lock is accomplished through inlet ports in the side walls of the river approach bay, ports in the walls of the lock chamber, and outlet ports in the sides of a system of tunnels in the bottom of the canal approach bay. These openings connect to culverts, 13.5 ft wide by 13.5 ft high, located in the base of the side walls of the lock and extending its full length. Flow through the culverts is controlled by reversed Tainter valves, hydraulically operated.

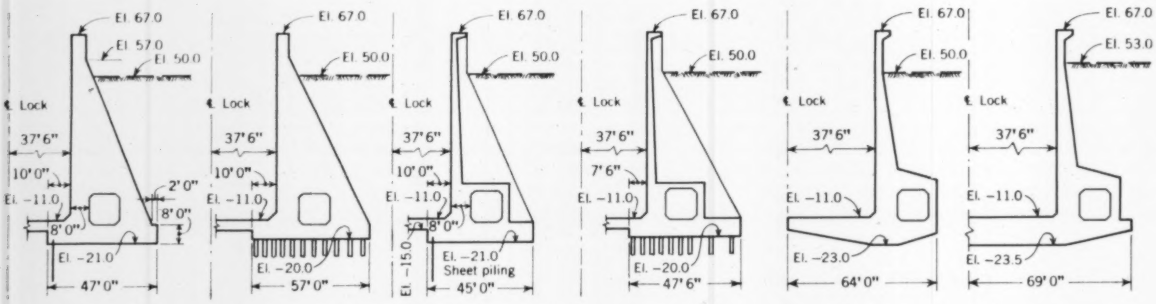
The lock gates are of the horizontally framed miter type, hydraulically operated, the distance from center to center of pintles being 1,245.5 ft. Slots are provided for placement of emergency bulkheads upstream and downstream of each pair of lock gates. Similar provision is made for placement of bulkheads in the culverts each side of each Tainter valve to permit the dewatering of each valve chamber for maintenance without dewatering the entire structure.

The central 17 monoliths comprising the lock chamber constitute the major masonry required and were consequently the subject of extensive study to determine the most satisfactory design. Consideration of the river and canal stages, the soil conditions and other factors led to the investigation of six basic types of structures for the lock chamber.

Preliminary sketches prepared for design study of each of the six cross-sections are shown in Fig. 2, "Comparative lock wall designs."

Cost studies indicated that the gravity sections and the sections founded on piles were uneconomical, the first because of the excessive mass of masonry required, and the second because of the added cost of piling. All sections required the installation of an underfloor drainage system to relieve the hydrostatic pressure in the sands below the floor with the exception of the "U-frame structure on sand."

Various underdrain systems were devised and studied with respect to initial cost and maintenance expense. An adverse water condition resulting in the chemical clogging of screens in the area caused major concern as to the feasibility of maintaining an effective



GRAVITY WALL ON SAND — **GRAVITY WALL ON PILES** — **COUNTERFORT WALL ON SAND** — **COUNTERFORT WALL ON PILES** — **L-WALL ON SAND** — **U-FRAME STRUCTURE ON SAND**

FIG. 2. Among comparative lock-wall designs, U-frame structure on sand was chosen.

dewatering system. Furthermore, high porosity of the sand and the large recharge area indicated that the underdrain system would have to be of substantial size to effectively relieve the pressure, the system being required to discharge as much as 30,000 gpm. Difficulty in maintaining the underdrain system, plus the possible disastrous consequences to the lock floor or structure if the underdrain system became clogged or began undermining sand from beneath the foundations, were subjects of serious concern.

Consideration of the fluctuating river and canal stages, the soil conditions, the difficulties with an underdrain system, the necessity for structural stability, and the overall cost of construction and maintenance, resulted in a decision to use the U-frame structure on a sand foundation for the entire length of the lock, this being the best design from the engineering and economic standpoints. The final design in a typical section is in the form of a U-frame measuring 75 ft wide and 78 ft high in interior dimensions. The base slab is typically 12 ft deep and the walls typically 9 ft thick at the root section just above the lock control culverts, tapering to 3 ft thick just below the deck. Cross-sections of a typical chamber monolith are shown in Fig. 3.

The U-frame sections are subject to many combinations of forces due to variations in water level in the lock during the operating cycle, fluctuations in ground-water pressures from the upstream end to the downstream end of the lock, fluctuations in ground-water pressures with variations in river stages and canal stages, and variations in the characteristics of the soil backfill against the walls. The varying forces from these influences create varying moments in the U-frame, with corresponding deflections. The deflections are reflected in varying soil reactions due to the compressibility of the foundation material.

After extensive study to determine the magnitude of these variations and limiting conditions for each major variable, equations were developed whereby stresses and elastic behavior in this U-frame section could be programmed on an IBM 650 electronic computer.

Some three weeks were spent in developing required equations and programming, but once the computer was set up and checked, solutions for 192 cases were run off in one afternoon, permitting complete review and analysis of the situation for any given set of conditions in a minimum time. This saving in time was extremely important since the Corps of Engineers had requested that the design program be accelerated to permit construction of the lock one season earlier than was originally contemplated when the design was started.

The third unusual design feature of the Old River Lock arises from a combination of geographical and topographical conditions with a unique concept of emergency closure procedures and lock maintenance operations. It will be noted that the lock forms a connecting link between the Mississippi and the Red Rivers, which drain two independent river basins. This permits a high river stage to occur on the Mississippi simultaneously with a low stage on the Red and Atchafalaya Rivers. Breaching of the gates during such a condition could result in disastrous consequences. Therefore it is imperative that definite means be provided for emergency closure of the lock in case of such an accident and, at times, for dewatering the lock for routine maintenance and inspection or for repair of accidental damage. Since the alternate route for barges in case Old River Lock is out of service could require a trip 170 miles longer than that through the lock, this lock must have a high degree of reliability. High-capacity lifting equipment normally is not available on the canal side and might not be able to reach points desired if it were nearby. Therefore a conventional revolving-type gantry crane is to be provided at the lock. This crane, permanently installed on tracks paralleling the lock, will handle emergency bulkheads for closure of the lock chamber and for closure of the culverts (to permit dewatering of valve chambers). It will also handle repairs to the lock gates, Tainter valves and operating mechanisms, and be available for maintenance operations, such as removing heavy driftwood logs that might become lodged in the lock.

The fourth unusual feature is the criteria governing the design of the guide walls at each end of the lock structure. The extreme fluctuation of water surfaces at both ends of the lock made the conventional rigid type of guide wall impractical as well as uneconomical. Such a guide wall would be a semi-rigid wall more that 80 ft high and 600 ft long at each end of the lock structure. It would need to be capable of resisting a horizontal force of 140 kips at a height of 80 ft above the channel bottom from the channel side, and 90 kips in the opposite direction, due to wind on the wall structure and the tow. To satisfy functions performed by the guide walls would have required facing the walls with a fender system for a height of more than 65 ft.

The best answer to the problem, as well as the most economical, both in first cost and future maintenance, is to use floating guide walls at both ends of the lock. The guide walls, which as designed are similar at both ends of the lock, consist of three reinforced-concrete floating pontoons secured through anchorages and guide beams to the ends of the lock structure and to reinforced concrete piers on steel bearing piles designed to resist the prescribed horizontal forces.

Anchorages at the ends of the lock and at each pier are in the form of Raykin fender buffers developed by General Tire and Rubber Company. These buffers are made up of a combination of rubber pads secured to steel supports in a manner that gives them ability to absorb large forces with limited amounts of movement. This limited movement reduces the shock loading that otherwise would be transmitted to the structure.

End piers at the outer ends of the guide walls serve as lateral anchors for the end pontoons and also provide protection for the ends of the guide walls.

During high water, it is possible for these piers to be hit by a tow from any angle within an arc of about 90 deg off the face of the pontoons. A weight of 17,000 tons moving at a speed of ½ fps, was assumed. The application of data obtained from previous experience by the Corps of Engineers indicated that the piers should be designed to withstand a horizontal force of 1,000 kips applied at El. 64. A steel sheetpile cell filled with sand was determined to be the least expensive means of satisfying the established design criteria. However, damage that might occur to the cell if it were hit by a tow, together with the cost and time required to repair the damage, caused the sheetpile cell to be abandoned.

A concrete pier on piles with a circular shaft of 30-ft outside diameter, with walls 4 ft thick and a well 22 ft in diameter, filled with sand, was found to best satisfy established design criteria and to require a minimum of maintenance.

The final unusual feature of the design is the location of a highway bridge and embankment just beyond the downstream gates of the lock. See Fig. 4. The bridge is being constructed by the Louisiana State Department of Highways. Agreement was reached whereby the main right-bank levee of the Mississippi River, forming the closure across Old River, could be combined with the approach roadways, a single embankment serving both purposes. The lock walls, with minor modifications, form the piers for the lift span of the bridge, with consequent savings.

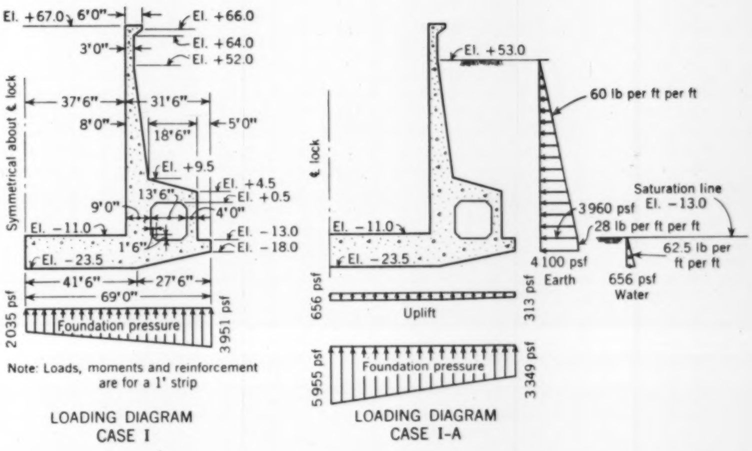

El. +67.0
6'0"
El. +66.0
El. +64.0
3'0"
El. +52.0
Symmetrical about ℄ lock
37'6"
31'6"
8'0"
5'0"
18'6"
El. +9.5
El. +4.5
13'6"
El. +0.5
9'0"
4'0"
El. −11.0
El. −13.0
1'6"
El. −18.0
El. −23.5
41'6"
27'6"
69'0"
2035 psf
Foundation pressure
3951 psf
Note: Loads, moments and reinforcement are for a 1' strip
LOADING DIAGRAM CASE I
℄ lock
El. +53.0
60 lb per ft per ft
Saturation line El. −13.0
3960 psf
28 lb per ft per ft
El. −11.0
El. −23.5
4100 psf Earth
62.5 lb per ft per ft
656 psf Water
656 psf
Uplift
313 psf
5955 psf
Foundation pressure
3349 psf
LOADING DIAGRAM CASE I-A

FIG. 3. Cross sections of a typical lock-chamber monolith are shown, with pressure diagrams.

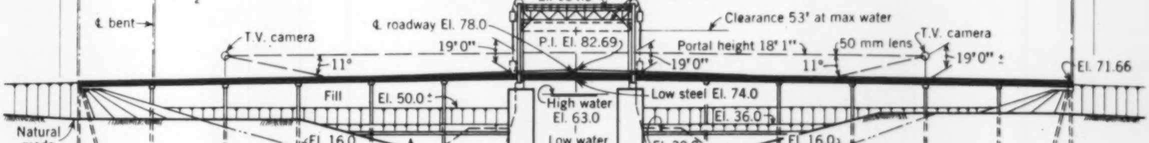
Safety and operational requirements dictated that the bridge operator be able to view the roadway before lowering the safety barriers and raising the bridge, and that the lock operator be at lock-deck level to view the approach channel under the bridge, the roadway being 11 ft above the lock wall to provide the necessary clearance. This difficulty is solved by placing both operations at adjoining control stations in a control room at lock deck level, permitting a direct view of lock operations; then closed-circuit television cameras and monitors will be installed to give the bridge operator a view of the bridge deck in both directions. As standby equipment, an optical periscope will be installed with the objective lens at a height sufficient to give sweep vision of the roadway.

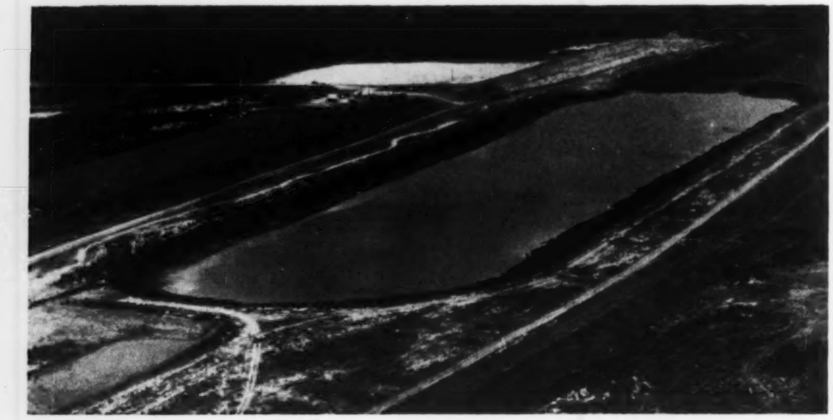
Under this plan, it was also feasible to work out joint use of standby generating equipment and other facilities. Design coordination was effected by the two agencies, federal and state, by awarding design contracts for the lock and bridge to the same architect-engineer firm.

The Old River Lock is being constructed by the New Orleans District of the Corps of Engineers, Col. George M. Cookson, M. ASCE, District Engineer. Soil studies and design of the excavation and dewatering systems were performed by the engineering staff of the District Office. The lock structure and appurtenances were designed under contract with the District Engineer by the joint venture of Bedell & Nelson Engineers, Inc., and A. W. Thompson and Associates, of which the authors are principals.

(This article is based on the paper presented by Messrs. Nelson and Thompson at the ASCE New Orleans Convention, before a joint session of the Construction and Waterways and Harbors Divisions presided over by Lawrence B. Feagin, a member of the latter Division's Executive Committee.)

FIG. 4. Highway bridge runs across the "canal end" of Old River Lock.


20'0"
6-65' composite welded spans = 390'0"
102' 1" vert. lift span
6-65' composite welded spans = 390'0"
20'0"
5½"
5½"
103'0" c to c cols
El. 134.5
El. 126.08
1'0½"
℄ bent
℄ roadway El. 78.0
Clearance 53' at max water
T.V. camera
19'0"
P.I. El. 82.69
Portal height 18'1"
50 mm lens
T.V. camera
11°
19'0"
11°
19'0" ±
El. 71.66
Fill
El. 50.0 ±
High water El. 63.0
Low steel El. 74.0
El. 36.0
Natural grade
El. 16.0
Low water El. 2.0
El. 30.0
El. 16.0
El. −15.0
Piers
El. −11.0
Piers
Sheet pile headwall
El. −28.0
El. −37.0
El. −23.0



Soft silt, under water in this area preexcavated for the lock, was not detected at time of bidding.

OLD RIVER LOCK construction planning

ROSS WHITE, F. ASCE, Vice President, Brown & Root, Inc., Houston, Tex.

The competent, experienced contractor starts his construction planning long before he has any assurance that he will actually perform a particular job. Much more work is offered than even the largest contractor can handle. He must therefore decide what specific job or jobs he will try to procure. This decision is affected by many factors such as geography, politics, equipment and personnel available, potential work load, anticipated competition, size of the job, etc. Up to this point the planning may be said to be a matter of company policy rather than of actual planning. For the Brown & Root organization, construction of the Old River Lock, located about 50 miles north of Baton Rouge, La., seemed interesting and desirable. See Fig. 1.

Old River Lock is a conventional Corps of Engineers navigation facility,

In early stage of dewatering of site, deep-well pumps in foreground are reducing hydrostatic pressure in foundation sands. Note the lights for night work.

connecting the Mississippi River with Old River and the Red and Atchafalaya River basins. It is a part of the major control work intended to prevent diversion of the Mississippi River from its present channel past Baton Rouge and New Orleans to the shorter route to the Gulf of Mexico via the Atchafalaya River. With the installation of these control works the lock becomes necessary to maintain a navigation connection between these great river basins. The lock construction requires drainage, earthwork, concrete and large amounts of steel gates, operating machinery, and other metal work. The bid price for the lock construction contract is $14,727,000.

There is a very close connection between what is clearly "planning" and what might perhaps be better called estimating. The two subjects, however, are so closely related that no attempt will be made to draw a line between them. The following discussion is applicable to almost any construction project.

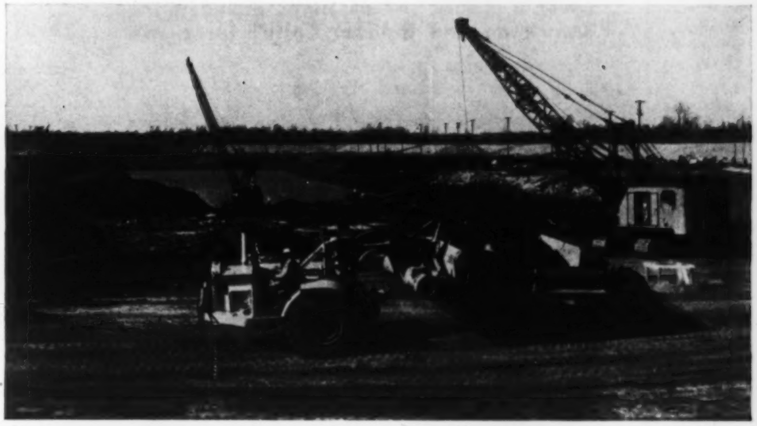
After tentatively deciding to bid on a job, the next logical step is to obtain plans and specifications. Time and expense can usually be saved by carefully studying these documents in the office before making a field inspection. This office study should reveal many of the natural and artificial boundaries of the job, such as location of access roads and railroads, right-of-way lines, and location of waste and borrow areas. Not the least of such boundaries to be looked for are such intangibles as arbitrary required rates of progress, seasonal limitations of work, specific limits on maximum variations in height of concrete, etc. If the work is on a stream, all available stream flow data should be studied.

Armed with this office picture of the job, field inspection is next in order. While important to any contractor, this field inspection is especially vital to the inexperienced builder. The field inspection should be very thorough even if a bidder feels he is quite familiar with an area. It will, of course, cover such matters as access by road, railroad, or water, and perhaps by air. Soil and rock foundation conditions will be studied. High- and low-water marks will be determined as well as depth to the water table. The field inspection must also determine whether suitable areas for camp, plant, and shops are available. In all but very remote projects, ample space must be available for employee parking.

Availability of local labor of all classes must be studied. It must be determined whether imported labor can find living quarters in towns within driving distance or whether a construction village must be built. Sources of concrete aggregate and riprap must be located and inspected. Availability and cost of electric power must be determined and a comparison made to determine if it is more economical to purchase electricity or to install the generating capacity needed. A water supply for both construction and domestic use must be located and its suitability determined.

The specifications should be carefully studied and any possible "jokers" given special consideration. If a prebid conference is scheduled, questions of interpretation can be discussed.

At this point the planner or estimator should be ready to make up a preliminary construction schedule. Such a schedule is a prerequisite to any intelligent planning for plant and labor required. The schedule should show not only the calendar time assigned to each operation but the hourly or daily rate of produciton assumed or required. Ev-



Initial preparation of plant site is under way here, with main Mississippi levee in background.

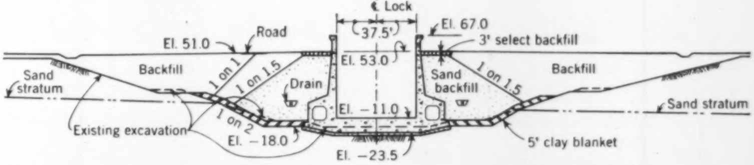


FIG. 1. Typical section through lock basin. All the construction plant had to be set on levees above El. 67.

Roads into the lock area are built as excavation is completed.

TABLE I. Check list of items included in "Overhead and Indirect Costs" for a job

Costs are listed in units estimated for labor, materials and supplies and for plant and equipment. This total is then distributed over the bid items.

General Manager
General Supt.
Assistant Supts.
General Foreman
Chief Engineer
Assistant Engineers
Office Manager
Chief Accountant
Chief Timekeeper
Purchasing Agent
Personnel Man
Office Help (incl. Timekeepers)
Chief Warehouseman
Warehouse Help
Police and Watchman
Janitors and Misc.

TOTAL SALARIES

Office Supplies
Office Equip. & Furniture
Engineering Supplies
Engineering Equipment
Telephone & Telegraph
Fuel & Heat
Drinking Water & Ice
Barricades & Signs
Permits & Licenses
Advertising & Contributions
Travel Expenses
Testing & Lab. Analysis
Legal Expense
Audit Expense
Consultant's Expense
Safety Expense
Medical Expense
Progress Photos
Sales Expense
Taxes—General
Taxes—Sales
Insurance—General

Job Sanitation
Job Construction Water
Job Telephone System
Job Power & Lights
Job Comp. Air System
Job Roads & Bridges
Job R.R. & Sidings
Office Bldg.
Warehouses
Carpenter Shop
Carpenter Shop Equip.
Machine Shop
Machine Shop Equip.
Misc. Bldg.
Maint. Temp. Bldgs. & Utilities
Rent—Offices & Whses.
Transport Personnel to Job
Move In and Mobilization
Special Rig Up
Move Out
Auto & Service Truck

School Expense
Camp Loss and Subsistence
Whse. Loss

Small Tools
Workmen's Supplies

WC-PL & PD Insurance
SS-OA-UC-Payroll Taxes

SUB-TOTAL OVERHEAD & INDIRECT

Performance Bond

TOTAL OVERHEAD & INDIRECT COST

ery possible or impossible method of doing the work should be set down and considered. Imagination should be given full play. Some ideas or methods can, of course, be discarded at once by the experienced man. There are at least a half dozen methods of handling excavation, such as shovels, drag-lines, elevating graders, scrapers, dredges, etc., and almost as many methods of hauling. Perhaps a choice must be made between quarrying and crushing concrete aggregates or the use of natural sand and gravel.

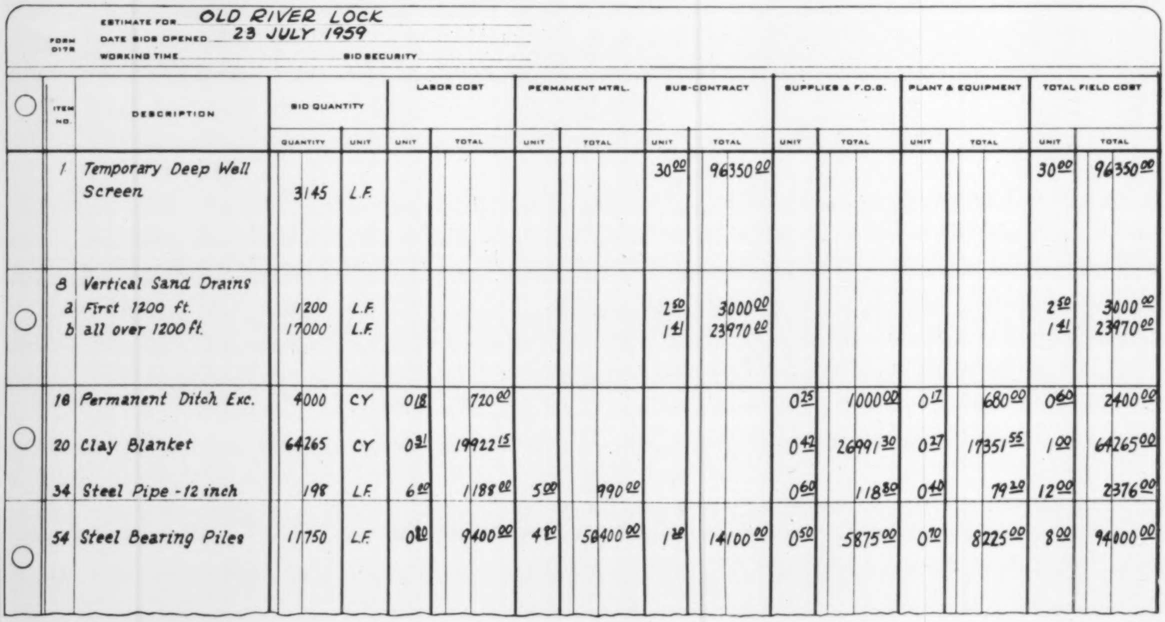
Concrete can be mixed in fixed or portable mixers; transported by truck, railroad, or pipeline, or if specifications allow, by belt conveyor. Placement can be by cableway or by any one of several types of rigs using movable booms, or directly by pump or belt conveyor.

There may be a choice between the floating or land type of pile drivers and frequently a choice between two or three different types of cofferdam and dewatering schemes. The planner or estimator must evaluate all these and many more possibilities to come up with the best answer for that particular job. He must have sound engineering advice on many features, such as type of foundation needed to support plant structures, size of air and water pipes to keep head loss within tolerable bounds, etc.

Having selected his tools or plant and set up his preliminary progress schedule, the planner can turn his attention to the labor side of the picture and start plotting the man-hour curve for the job. If this curve has many peaks and valleys, it is a strong indication that changes in methods, schedule, or plant are desirable. Irregular employment is undesirable from almost every angle.

Having established his best choice of methods, schedule, and plant, the planner-estimator is in a position to prepare the indirect cost sheet. Table I is a reminder list used by Brown & Root. Not all items are applicable to all jobs. Carelessness or ignorance has very frequently caused a contractor to overlook the indirect costs which usually amount to a substantial percentage of the direct cost. Labor, permanent material, supplies, plant and equipment charges for each bid item are set up on a sheet shown partly as Fig. 2. Each bid item should be priced to return at least its actual cost as quantities may vary substantially in the field. Sometimes bids may be profitably unbalanced by adding a disproportionate share of the indirect cost, especially to items that will be completed early. This must be recognized as a gamble as a change of plans may cause serious loss of expected income.

FIG. 2. Typical bid-item estimate for Old River Lock.



FORM 0178
ESTIMATE FOR OLD RIVER LOCK
DATE BIDS OPENED 23 JULY 1959
WORKING TIME
BID SECURITY

	ITEM NO.	DESCRIPTION	BID QUANTITY		LABOR COST		PERMANENT MTRL.		SUB-CONTRACT		SUPPLIES & F.O.B.		PLANT & EQUIPMENT		TOTAL FIELD COST	
			QUANTITY	UNIT	UNIT	TOTAL	UNIT	TOTAL	UNIT	TOTAL	UNIT	TOTAL	UNIT	TOTAL	UNIT	TOTAL
○																
	1	Temporary Deep Well Screen	3145	L.F.					30^{00}	96350^{00}					30^{00}	96350^{00}
	8	Vertical Sand Drains														
○	a	First 1200 ft.	1200	L.F.					2^{50}	3000^{00}					2^{50}	3000^{00}
	b	all over 1200 ft.	17000	L.F.					1^{41}	23970^{00}					1^{41}	23970^{00}
	16	Permanent Ditch Exc.	4000	CY	0^{18}	720^{00}					0^{25}	1000^{00}	0^{17}	680^{00}	0^{60}	2400^{00}
○	20	Clay Blanket	64265	CY	0^{31}	19922^{15}					0^{42}	26991^{30}	0^{27}	17351^{55}	1^{00}	64265^{00}
	34	Steel Pipe - 12 inch	198	L.F.	6^{00}	1188^{00}	5^{00}	990^{00}			0^{60}	118^{80}	0^{40}	79^{20}	12^{00}	2376^{00}
○	54	Steel Bearing Piles	11750	L.F.	0^{80}	9400^{00}	4^{80}	56400^{00}	1^{20}	14100^{00}	0^{50}	5875^{00}	0^{70}	8225^{00}	8^{00}	94000^{00}

Before his planning for the job is complete, the planner-estimator should plot curves delineating the anticipated cash income and outgo during the life of the contract. The distance between these income and outgo lines shows the amount of capital needed to carry the job. Failure to make this study and arrange in advance for adequate financing has been disastrous to many contractors when job progress reveals the need for more capital than had been anticipated. Even if money can be borrowed easily, use of money is an expense that should be included in job overhead.

For Old River Lock, plans and specifications were obtained and studied and field inspections were made by two different groups of engineers. These field studies quickly revealed the ready availability of water transportation on all the connecting waterways and also the availability of suitable roads from the local roadway network and from a possible railhead only a few miles away.

There was adequate, but not unlimited, working space available at the site. Most labor could be obtained from the local area. Supervisors and skilled workers who had to be imported could find living facilities within driving distance of the project. Therefore no camp or living quarters had to be built at the site.

Aggregate for about 200,000 cu yd of concrete would have to be moved to the site. Very substantial amounts of steel, cement and the like would also have to be provided. Very thorough analyses were made of the relative cost of water versus road delivery, for the method of delivery affected not only the direct cost but the whole plant layout as well. Somewhat surprisingly these studies indicated that, all things considered, road delivery would provide the more economical answer, and this method was selected.

Since a conventional central mixing plant was required by the specifications, the concrete production setup had to be planned around it. As the whole area is subject to flooding during high river stages, this unit obviously had to be placed on top of the surrounding levees. Since the concrete had to be moved down to the lock floor at an elevation nearly 80 ft lower, trucks were logically selected instead of a railroad for concrete transportation on the job.

For handling concrete from the mixer into the forms, a cableway was considered, located either transversely or longitudinally of the lock. A careful study of long-boom whirley cranes or heavy-duty crawler cranes was also made. The final choice was in favor of crawler cranes, largely because of their versatility and high salvage value.

A study showed that steel forms would be more economical than wooden ones. The planning for forms then consisted mainly of schedule studies to determine the construction approach both to comply with the specification as to limited differences in elevation of the monoliths and to permit the minimum purchase of the expensive steel forms to meet the required schedule of construction.

Specifications required site drainage by deep wells and sand drains, so this phase of the work, which often presents many problems, was removed from construction planning. However, it was still necessary to make a careful analysis and layout of roads, ditches, and pumps to handle surface drainage.

The Old River Lock requires substantial but not major amounts of earthwork, both excavation and fill. The study indicated scrapers as the best tool for most of this, with some use for draglines and bottom-dump trucks. The cranes needed for concrete placement could readily be converted to draglines and would be available for excavation before the concrete placing started.

An unexpected development in actual construction was the finding of some 80,000 cu yd of very soft, soupy silt on the bottom of the foundation pit, which had been excavated under a previous contract. This soupy material had been under deep water during the prebidding period and was so soft that it could not be detected by any normal sounding method. It has had to be removed by a hydraulic suction dredge. This development is mentioned only to demonstrate that even the most careful examination and planning cannot always reveal all contingencies.

A drawing was prepared showing plant layout, roads, parking area, etc., and a construction schedule was made up. From this schedule the number and size of the plant units required could be determined. Further analyses were required to see whether, within the limits of time available, it was more economical to use, say, one dragline two shifts a day or two draglines one shift a day. It frequently is found on construction that expensive equipment can profitably be operated two shifts a day; dredges and the like can work three shifts. Sometimes concrete placing can be more economically done on an afternoon and night shift, leaving the equipment available for moving forms and the like during the day. Double shifts on carpentry work are undesirable; a third shift seems to add almost nothing to overall progress.

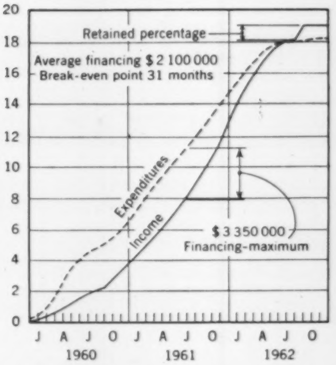


FIG. 3. Money requirements for a hypothetical $19,000,000 job are shown graphically.

With the overall schedule and plant selected, it was possible to plot a man-hour curve and make an organization chart. With the aid of the so-called "tickler sheet" of Table I, listing the scores of possible indirect cost items, a tabulation of indirect expenses was made.

With all this information at hand, together with quoted or estimated costs for plant and materials, the planner-estimator team put prices on bid items.

Applying the bid prices to quantities taken from the progress schedule, the cash income curve could be plotted. Still working from the progress schedule and man-hour curve, the timing of required expenditures was established and the "outgo" curve plotted. The distance between these "income-outgo" curves clearly indicates the capital requirements of the job. See Fig. 3.

Finally, a concise summary of the planning-estimating study was prepared, for the record, and for use by company executives in submitting a bid.

As construction proceeds on the project, careful comparisons are made between planned and actual results, to keep a check on job costs so that top management will be alerted to delays and higher than estimated unit costs. By prompt action, an error in estimating and planning, or slackness in pushing the work, can be corrected before the entire job bogs down. Comparisons of progress and cost with the estimate are most helpful, as well, for estimating future jobs.

(This article is based on the paper presented by Mr. White at the ASCE New Orleans Convention, before a Construction Division session presided over by Walter L. Couse, a member of the Division's Executive Committee, and Roy G. Cappel, F.ASCE.)

Prestressed concrete sheetpiles for bulkheads and retaining walls

W. E. DEAN, F. ASCE, Assistant State Highway Engineer (Structures), Florida State Road Department, Tallahassee, Fla.

Many fills in and along shallow coastal waterways are included in the projects of the Florida Road Department. In protecting and retaining these fills, use is made of thousands of feet of concrete sheetpile wall. These walls are placed in a variety of structures, as illustrated in Fig. 1, including splash walls and groins. Present construction practice is to use prestressed concrete for the sheetpiles in most of these walls. For this type of sheetpile construction, prestressed concrete is considered an improvement over reinforced concrete and has practically replaced it, just as reinforced concrete replaced treated timber about twenty years ago in similar structures.

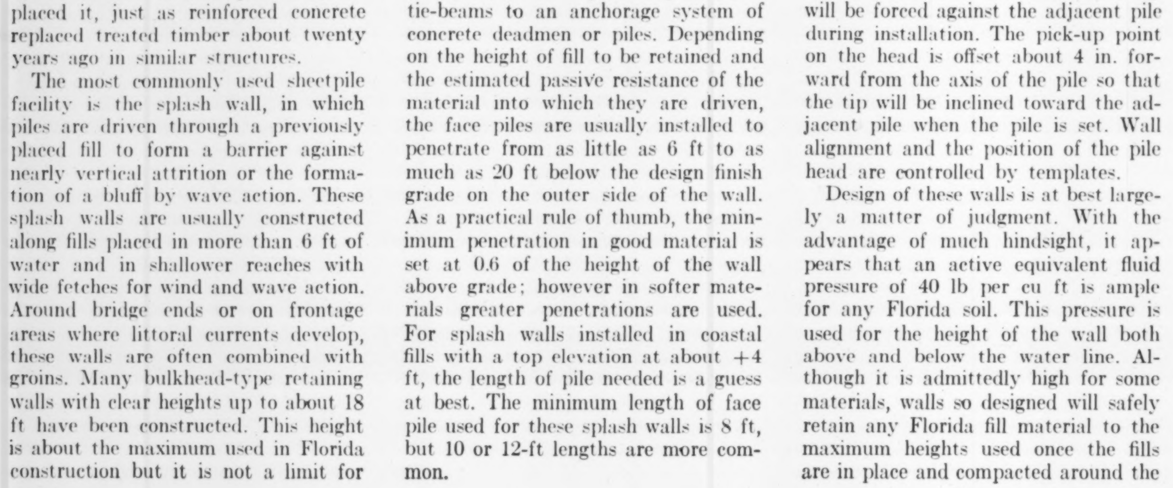
The most commonly used sheetpile facility is the splash wall, in which piles are driven through a previously placed fill to form a barrier against nearly vertical attrition or the formation of a bluff by wave action. These splash walls are usually constructed along fills placed in more than 6 ft of water and in shallower reaches with wide fetches for wind and wave action. Around bridge ends or on frontage areas where littoral currents develop, these walls are often combined with groins. Many bulkhead-type retaining walls with clear heights up to about 18 ft have been constructed. This height is about the maximum used in Florida construction but it is not a limit for satisfactory and economical walls of this type. At bridge ends these walls can be combined with end bents to form closed-type abutments or, for the open type, they can be placed to retain fills.

The construction type used for these various retaining walls, as shown in Fig. 2, is generally similar, with sizes of members and details proportioned in accordance with particular design requirements. A face wall of prestressed concrete sheetpiles is capped with reinforced concrete and tied back with a system of precast prestressed tie-beams to an anchorage system of concrete deadmen or piles. Depending on the height of fill to be retained and the estimated passive resistance of the material into which they are driven, the face piles are usually installed to penetrate from as little as 6 ft to as much as 20 ft below the design finish grade on the outer side of the wall. As a practical rule of thumb, the minimum penetration in good material is set at 0.6 of the height of the wall above grade; however in softer materials greater penetrations are used. For splash walls installed in coastal fills with a top elevation at about +4 ft, the length of pile needed is a guess at best. The minimum length of face pile used for these splash walls is 8 ft, but 10 or 12-ft lengths are more common.

The prestressed concrete sheetpiles used as Florida standards have a uniform width of 30 in. and vary in thickness from 6 to 12 in. On one edge there is a groove for the full length. On the other edge there is a groove extending from the top of the pile to a point that will be three or four feet below the water line after the pile has been driven. Below this point the groove is replaced by a tongue. The recess formed by this groove and the one on the adjacent pile is filled with grout after driving. The foot of the pile is beveled on one side so that the tip will be forced against the adjacent pile during installation. The pick-up point on the head is offset about 4 in. forward from the axis of the pile so that the tip will be inclined toward the adjacent pile when the pile is set. Wall alignment and the position of the pile head are controlled by templates.

Design of these walls is at best largely a matter of judgment. With the advantage of much hindsight, it appears that an active equivalent fluid pressure of 40 lb per cu ft is ample for any Florida soil. This pressure is used for the height of the wall both above and below the water line. Although it is admittedly high for some materials, walls so designed will safely retain any Florida fill material to the maximum heights used once the fills are in place and compacted around the

FIG. 1. Along Florida's shallow coastal waterways, the typical sheetpile structures shown are used to protect and retain fills.



SPLASH WALL

GROINS

RETAINING WALL

BRIDGE ABUTMENT

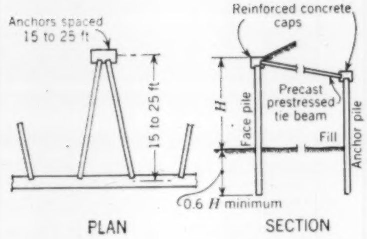

Anchors spaced 15 to 25 ft
15 to 25 ft
PLAN
Reinforced concrete caps
H
Face pile
Precast prestressed tie beam
Fill
Anchor pile
0.6 H minimum
SECTION

FIG. 2. Typical concrete sheetpile retaining wall consists of a face wall of prestressed concrete sheetpiles capped with reinforced concrete and tied back to an anchorage system with precast prestressed tie-beams.

anchorage systems. Very little trouble from distortion has been experienced with walls in place and retaining carefully placed fills; however the design criteria have their limitations. For instance, the saturated effluent from a large dredge discharging immediately behind a newly placed wall is likely to result in serious distortion or failure unless carefully controlled. Where the wall has to be placed first and then the fill placed by dredging, care must be taken to leave ample openings so that the fluid pressure does not build up to failure load. The dredge discharge has either to be placed slowly against the wall or diked initially and later placed dry, first around the anchorage system, then over the wall.

Cross sections of four standard sheetpiles are shown in Fig. 3. Experience shows that the empirical criterion of minimum concentric prestressing to 700 psi applied to these sections at transfer will provide a member that can be safely hauled, handled and placed with little danger of cracking.

Considering only working loads, it would be logical for sheetpiles restrained at the heads and tips, to have the greater part of the reinforcing and a higher prestress in the front face. However practically all Florida piles are constructed with the prestress reinforcing symmetrical with respect to the front and back faces. With this arrangement the pile can be handled from either side or end, and in most cases the minimum prestressing is sufficient to resist working loads below the cracking stress. In a few cases, for higher walls, mild steel bars have been used to supplement the prestressing in the front face.

Most walls require a number of special sections for corners and angles. These special sections (Fig. 4) are reinforced rather than prestressed because it is impracticable to produce the limited number required on long prestressing beds.

These prestressed-concrete sheetpile groins on a Gulf of Mexico beach in Manatee County, Fla., were photographed from a U.S. Coast Guard helicopter.

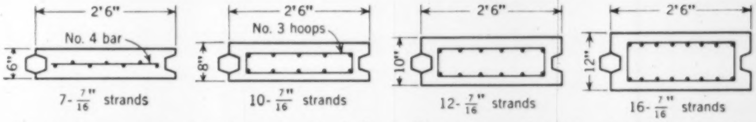
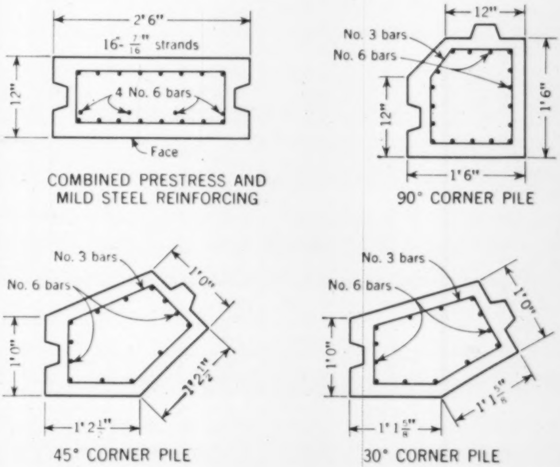
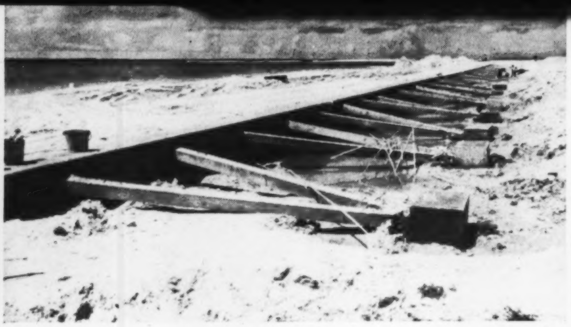

2'6"
No. 4 bar
6"
7-7/16" strands
2'6"
No. 3 hoops
8"
10-7/16" strands
2'6"
10"
12-7/16" strands
2'6"
12"
16-7/16" strands

FIG. 3. Cross sections of four standard sheetpile sections show prestressing strands.

FIG. 4. Special concrete sheetpile sections, without prestressing, are used for corners and angles in most walls. The three corner piles shown are for a 12-in. wall, and other wall sizes are similar. At upper left is a special prestressed pile section which includes both prestressing and mild steel reinforcing. All 7/16-in. strands are prestressed to 18,900 lb.


2'6"
16-7/16" strands
12"
4 No. 6 bars
Face
COMBINED PRESTRESS AND MILD STEEL REINFORCING
12"
No. 3 bars
No. 6 bars
12"
1'6"
1'6"
90° CORNER PILE
No. 3 bars
No. 6 bars
1'0"
1'0"
1'2 1/2"
1'2 1/2"
45° CORNER PILE
No. 3 bars
No. 6 bars
1'0"
1'0"
1'1 5/8"
1'1 5/8"
30° CORNER PILE

Bulkheaded area in Biscayne Bay, near Miami, Fla., is being filled in. Water depths at the face of the wall are up to 15 ft.



An open bridge abutment may be combined with a groin, as seen above. At right, a completed splash wall is seen before backfilling. This is on the west approach to the Third Bay Bridge, Pinellas County, Florida.

Concrete sheetpiles are placed by a variety of methods depending on the material in which they are installed. Most piles are simply jetted to grade in the prevailing granular soils of Florida. The weight of a pile being placed is sometimes supplemented by the weight of another pile placed on top to assist the jet penetration. Where the foundation material is not easily erodable, steam or gravity hammers are used with driving blocks. For penetration in dense material, prepunching or blasting of trenches is often required.

Depending on the height of the fill and the type of material retained, anchorages may consist of concrete deadmen, either cast in place or precast, single piles, a combination of pile and deadman or pile clusters, as generally indicated in Fig. 5. The type most commonly used is the single capped pile. This may be either a sheetpile similar to those used in the face wall or a driven pile of heavier type.

The tie-beams connecting wall and anchorage are precast prestressed members. Details of two sizes are shown in Fig. 6. The size of these ties and their spacing along the wall are of course dependent on design requirements. The beams are attached to the cast-in-place wall cap and anchor cap by the protruding steel. It should be noted that this steel is not an extension of the stressing cables but is an entirely different system of bars or cables. Use of the stressing tendons for anchorage attachment would add to the high stress already in these tendons, and yielding or rupture would probably result.

One of the most critical construction requisites is to get a tight face that will not leak fill material near the water line where the constant splash and pumping action of the waves has to be resisted. Even the smallest crack in this zone will permit large quantities of fill material to pass through and, once leakage starts, repairs are difficult and expensive. The use of tongues and grooves with the best construction practices will not provide leak-proof construction. If a wall is to prevent fill leakage in the zone of wave action it must be practically watertight. The only satisfactory method as yet devised for this sealing is continuous grouting between sheetpiles from 3 to 4 ft below the water line to the top of the piles.

Grouting of the grooves has to be done carefully if a satisfactory seal is to be obtained. Piles are seldom driven with the edges in actual contact, and the grout has to be placed several feet below the water level, usually while there is some wave action. Therefore it is necessary to chink the adjacent pile edges and the bottom of the grout recess if serious leakage is to be avoided. One Florida contractor recently devised the most successful method yet

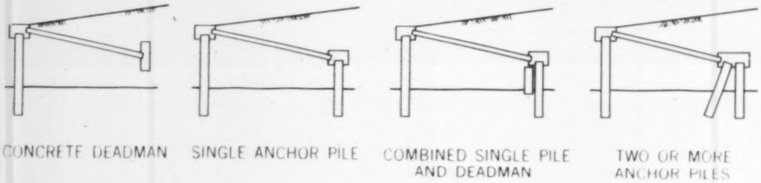

CONCRETE DEADMAN
SINGLE ANCHOR PILE
COMBINED SINGLE PILE AND DEADMAN
TWO OR MORE ANCHOR PILES

FIG. 5. Type of anchorage used for retaining walls depends on height of fill and type of material retained.

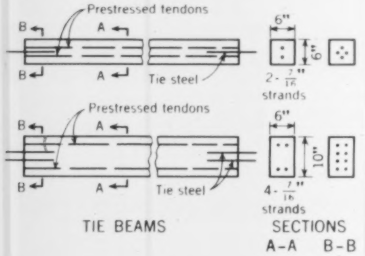

Prestressed tendons
B
A
B
A
Tie steel
6"
6"
2-7/16" strands
Prestressed tendons
B
A
B
A
Tie steel
6"
10"
4-7/16" strands
TIE BEAMS
SECTIONS
A-A B-B

FIG. 6. Tie-beams connecting wall and anchorage are precast prestressed members.

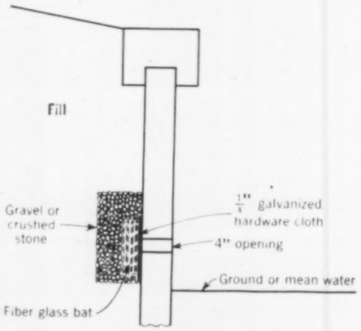
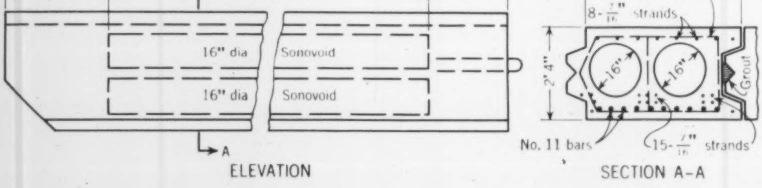

Fill
1/4" galvanized hardware cloth
Gravel or crushed stone
4" opening
Ground or mean water
Fiber glass bat

FIG. 7. On occasional jobs the nature of the retained material or the height of the fill makes drainage necessary. Then openings are provided to permit passage of water while retaining the fill material.

FIG. 8. Large prestressed pile illustrates the structural potentialities being considered for prestressed concrete in this field.


4' 0"
Stop voids at these points
3' 0"
A
16" dia
Sonovoid
16" dia
Sonovoid
A
ELEVATION
4' 0"
No. 4 ties
8-7/16" strands
2' 4"
16"
16"
Grout
No. 11 bars
15-7/16" strands
SECTION A-A

tried for securing tight joints between sheetpiles. A thin polyethylene tube is placed over the grout pipe, which is then lowered to the bottom of the recess. When filled with grout, the tube is forced out against the sides of the piles, completely filling the void. The presence of the plastic tube of course prevents any bond between the grout and the piles but the seal is very effective and bond between piles is not really necessary in a uniformly loaded wall.

The prevalence of granular material for fill and the usual height of the water table makes drainage through these walls a matter of no concern on most Florida projects. On the occasional job where the nature of the retained material or the height of the fill makes drainage necessary, openings must be provided that will permit the passage of water while still retaining the fill. Such a drain is shown in Fig. 7.

Large piles planned

Numerous accounts of various projects using prestressed concrete sheetpiles have recently appeared in the technical press. Some of these described much larger pile sections and more complex structures than are discussed here.

The largest prestressed concrete pile that has come to my attention is shown in Fig. 8. This 2-ft 4-in. by 4-ft sheetpile, weighing about 1,000 lb per lin ft in the section where the voids are, was proposed for a pier wall in Pensacola Harbor, where large freighters would be docked. The design water depth on the face of the wall would be 35 ft. The sheetpile wall would be combined with a relieving platform constructed above water. The piles proposed were in lengths of 60 ft and longer and would weigh in excess of 30 tons each.

Although the project for which this pile was proposed has not been built, this section is claimed to be competitive in cost with equivalent steel sheetpiles and it offers the advantage of a corrosion-free marine structure.

This pile is mentioned merely to illustrate the structural potential being considered for prestressed concrete. As in the many other structural applications of prestressed concrete, the possibility of economical and expanding use of sheetpiles should be considered by engineers designing permanent structures in which this type of member is applicable.

(This article was originally presented by Mr. Dean at the ASCE New Orleans Convention, before the joint session of the Structural and Construction Divisions presided over by Nathan D. Whitman, Jr., a member of the Structural Division's Executive Committee.)

QUICK, inexpensive, and accurate wire models

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The Müller-Breslau principle, like Maxwells' principle of reciprocal deflections from which it derives, applies to any elastic structure and can be stated:

The ordinates of the influence line for any function (e.g., a reaction or a moment) are equal to those of the elastic curve that is produced by the removal of the restraint corresponding to the function and the introduction of a unit deformation in its stead (e.g., a unit deflection in place of a reaction, a radian angle change in place of a moment).

Such deformations are more conveniently applied to models than to real structures. Loads are not applied to the model. Of course forces are required to produce the unit deformation that results in the elastic curve, but these forces are not measured and their magnitudes are of no use. Such models are, in fact, often called "unloaded models." Hence the model can be made of any material that will produce an elastic curve which is geometrically similar to the related elastic curve of the prototype.

If a model be displaced by an amount Δ at a reaction point, the elastic curve is the influence line for the reaction, R, whose value is computed simply as

$$R = \frac{\Sigma P y}{\Delta} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (1)$$

where P is a load on the prototype and y is the corresponding deflection component of the load point on the

Technique and equipment for rapid analysis of rigid frames, arches, and rings with either prismatic or nonprismatic members

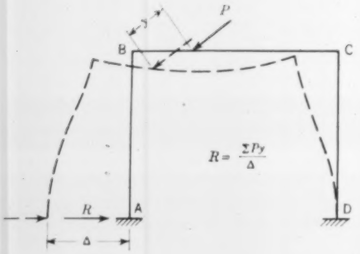


FIG. 1. Elastic curve is influence line for horizontal reaction, R.

FIG. 3. Influence line for moment, M, is shown. Equal and opposite deformations eliminate geometrical distortion. Scale measures vertical components of influence line.

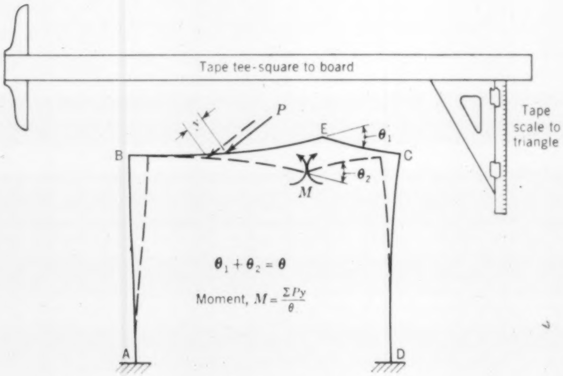
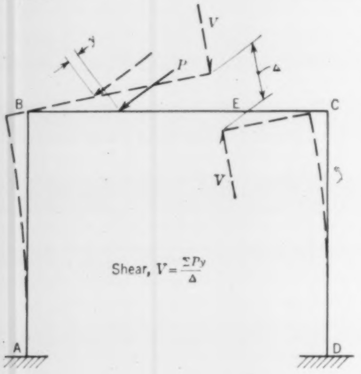


FIG. 2. Influence line for shear, V, is shown. Note prevention of relative rotation and axial deformations of cut ends.

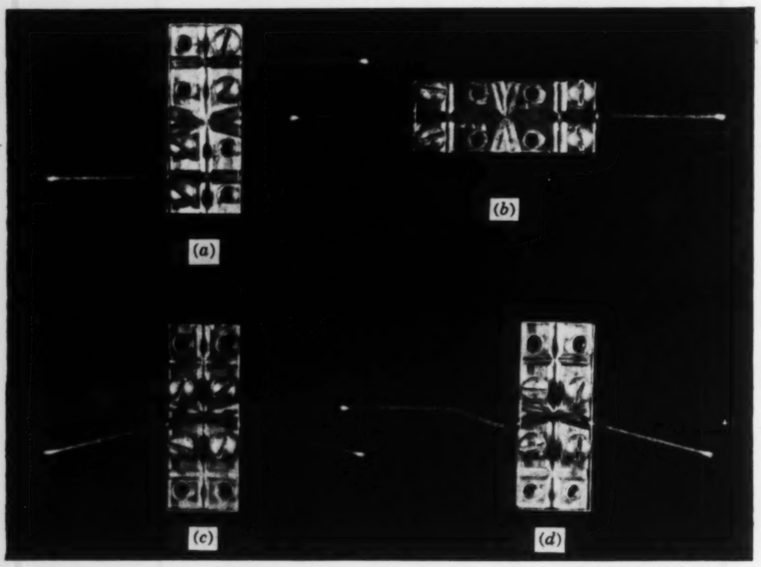


model measured *parallel to the load*, as shown in Fig. 1. (When the deformation, Δ, is unity it drops out of the equation, leaving only the mathematical definition of an influence line.) It is possible to extend Eq. 1 to internal forces such as shear or thrust by cutting the model and introducing a differential deformation, as shown in Fig. 2. The cut ends must be permitted to "float" into position completely unrestrained by any unbalanced external forces—although equal and opposite forces may be applied to prevent axial deformation and moment deformation. Moment at any point can be found by cutting the model and introducing a unit relative rotation (one radian) between the cut ends. The moment is computed as

$$M = \frac{\Sigma P y}{\theta} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (2)$$

where θ is the relative rotation in radians. Physically, a full radian would produce a geometrical error of about 4 percent in a simple beam, whereas a half radian of relative rotation produces a geometrical error of only about 1 percent. By using *equal and opposite* deformations, as shown in Fig. 3, errors can be greatly reduced without loss of sensitivity. By measuring deflections only for equal-opposite deformations (and never from one deformation to the neutral position) certain other geometrical distortions are eliminated entirely. The terms Δ and θ then become the arithmetical sum of the two opposite deformations.

FIG. 4. Deformeters show deformation of: (a) one inch in shear, (b) one inch in thrust, (c) one-half radian in moment, (d) one-quarter radian in moment. Transposition of wires yields equal and opposite deformations. The neutral, bent wire at left in (d) is not moved either for moment or for shear.


(a)
(b)
(c)
(d)

History

The first practical application of the Müller-Breslau principle in the United States was reported in 1922 by George E. Beggs,[1] who developed a deformeter[2] to produce precise displacements either internally or at the supports. The deformations are controlled by gage plugs polished to a tolerance of only ten millionths of an inch. Movements are measured by filar microscopes. In experienced hands it consistently produces superb results.

In a deformeter[3] invented by Eney,[4] movements are produced by positioning pins pushed through accurately machined holes. It too produces excellent results and is easier to use and less costly than the expensive Beggs deformeter. Both of these deformeters are used with models of cardboard or plastic.

In 1927, Anders Bull,[5] F.ASCE, suggested the use of brass drill-rod for the making of models. Wire possesses several advantages over cardboard or plastic. Deflections can be so large that the shape of the influence line is plainly evident, the material is cheap, and manipulation of the models is easier and usually faster. Unfortunately, certain practical difficulties have prevented the use of the wire model except for demonstration in the classroom, and errors have been so great that engineers have been reluctant to pin much faith on the results. These difficulties involve: lack of a suitable deformeter, lack of a suitable means for varying the stiffness of the wire to represent haunches and tapered members, creep in soldered joints, and lack of manipulative techniques to yield precise results.

Improved techniques, better solder, an accurate deformeter, and a practical means for varying the stiffness of the wire within wide limits now make the use of wire models practical for either prismatic or non-prismatic continuous beams, rigid frames and arches. In comparison with cardboard and plastic models the wire models are usually quicker and easier to make, and they are certainly easier to handle. In ease and speed of manipulation they compare closely with the Eney deformeter and are supeior to the Beggs deformeter. The accuracy is sufficient for all practical purposes. Equipment and material costs are less than for other deformeters. Some complex structures such as the gabled frame, to be discussed later, can be analyzed more quickly by a wire model than by any of the well-known analytical methods.

Deformeter for wire models

To make wire-model study practical we need a deformeter that is small, light, accurate, easy to use, and either easily made or inexpensive. The deformeter of Fig. 4 meets all these requirements. The production model is made of a small piece of 7075-T6 aluminum alloy into which 75-deg V-grooves are milled in a pattern that permits deformation in moment, thrust and shear as shown. The wires are clamped into the V-grooves by a Plexiglas cover plate held by small screws. Except for the Plexiglas cover (which can easily be replaced), it is quite rugged and not likely to break or become inaccurate unless deliberately abused. It produces a moment deformation of one-half radian, a thrust deformation of one inch, and a shear deformation of one inch. Equal and opposite deformations can be made for moment and shear. If equal and opposite deformations are required for thrust (as in arches), the cut ends can be slightly displaced laterally so they can slide past each other, and a stiff "pigtail" soldered to each cut end. Pigtails are clamped into shear grooves.

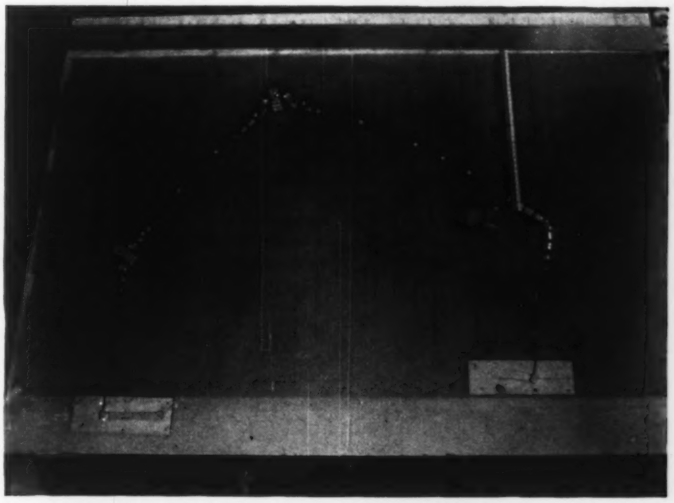


FIG. 5. Wire model of gabled rigid frame shows properly soldered joints. Note deformeters, stiffeners to simulate haunches, and ball supports. There is a deformation of ½ radian at the top.

For the wire, brass drill-rod is usually best.[6] Carbon-steel drill-rod is much stiffer and is sometimes to be preferred. Oxyacetylene welding and brazing rods are universally obtainable in 3-ft lengths at any welding supply store. They are not round and their stiffnesses vary appreciably on different axes. Stiffness varies from piece to piece and it even varies slightly along the same wire on the same axis, but even so, this material is very useful if every piece is calibrated on the axis of orientation to be used in the model.

Gussets and stiffeners. Gusset plates (used at joints) and stiffeners (soldered at intervals along the wire to vary the stiffness) can be made from a tin can, but galvanized sheet iron in 26 gage (0.019 in.) is better, and scraps are always available for the asking. Lead solders and zinc solders creep too much to permit accurate model tests. The only satisfactory solders known to the writer are Alloy No. 10 (90 percent tin and 10 percent silver) and a special alloy of 85 percent tin and 15 percent silver, which appears to be slightly better.[7]

Properly soldered joints are shown in Fig. 5. Wire should be enclosed in a fat solder "bubble" whose meniscus must not appreciably overlap the stiffener plate if accurate control of stiffness is to be achieved. A good joint can be obtained by pressing the soldering iron on top of the joint fluxed with tinner's acid, being careful not to let the tip of the iron overlap the stiffener. The solder should be fed into the side of the iron, letting it flow by itself all over the joint. The iron is then lifted and no attempt is made to retouch the joint. With a bit of practice this can be done quickly and surely. It is helpful to tape all the gussets, stiffeners and wires to a piece of asbestos-cement board to prevent displacement while the soldering is being done. Any protruding meniscus can be filed away.

Scale. An engineer's scale can be used, but a reading error of only 0.01 in. may often produce a percentage error of 2 percent. A scale graduated into 100 divisions per inch (such as Keuffel & Esser Co.'s No. 1418 P) can be read to 0.002 in. with a 5 X to 10 X glass and is consequently much superior. One way to hold the scale for accurate measurements is shown in Fig. 3. (The writer splits his scales longitudinally, using the 100 scale for model measurement and the 80 scale in the wire calibration device.)

A complete list of equipment and supplies is given in Table I together with approximate prices of those items not so likely to be found in most structural offices.

Wire calibration

The stiffness of the wires must be determined by measurements of deflection under load. A simple device

FIG. 6. Calibrating apparatus, used to determine relative stiffness of wires, is a simple device made with push-pins.

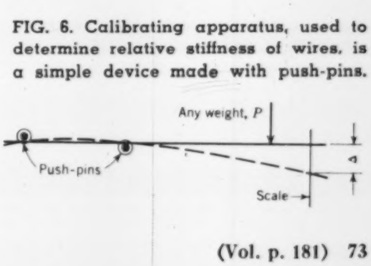


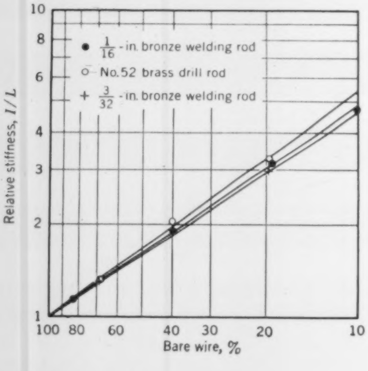
TABLE I. Equipment and supplies

Items	Approximate Price
Asbestos-cement board for soldering, 24 in. x 24 in.	$1.20
Steel balls, 1 dozen, 1/8 in. or 3/32 in.	0.10
Bronze and steel acetylene welding rods, 1/16, 3/32, 1/8 in., 10 of each in 3-ft lengths	4.00
Center punch	0.55
Deformeter	15.00
Drafting tape	....
Drawing board, 31 in. x 42 in. minimum	6.90
Drawing ink, India	....
Engineer's scale	....
File, 6-in. mill bastard	0.65
Galvanized iron scraps, No. 26 gage	....
Glass, 1 dozen, 1 in. x 2 in. (double-depression microscope slides are ideal)	....
Hammer	....
Hand drill, Stanley No. H 1221 or equivalent	4.00
Pliers, Bernard or equivalent	2.50
Push pins, size No. 1, two packages of 5 each	0.30
Ruling pen	....
Solder, 1 lb, 90 percent tin and 10 percent silver	6.50
Soldering acid, 3 oz.	0.25
Soldering iron, Stanley No. 450, 135 watt or equivalent	6.50
Tin (use a coffee can)	....
Tin snips	2.50
Tracing paper	....
Twist drill, No. 58	0.45
Other desirable items	
Drill rod, brass semi-hard, 3-ft length, diameters from 0.042 in. to 0.100 in., five of each in 15 sizes	15.00
Drill rod, carbon steel, 3-ft length, diameters from 0.042 in. to 0.100 in., five of each in 24 sizes	21.00
Jewelers eye loupe, Bausch & Lomb, Cat. No. 2"-5x 81-41-72 (or a double transit reading-glass)	1.50
Scale, 100 divisions per inch, K. & E., 1418 P or equivalent	5.90

made with push-pins is shown in Fig. 6. Since only the relative stiffnesses are needed, anything will do for a weight. Accuracy in measurement requires a deflection of at least 0.25 in., but to prevent excessive geometric distortion, the deflection must be limited to about 6 percent of the total span length. If wires of widely differing stiffnesses are to be calibrated, a number of equal weights are desirable so that one to several may be used to provide the proper deflection.

If the prototype is composed of members with three or more different stiffnesses and if there are a great many different wires, a trial-and-error selection is cumbersome. A good way is to calibrate each wire and plot its relative stiffness on two-cycle logarithm paper. Cut a narrow strip of the log paper and plot on it the relative stiffnesses of the prototype members. By sliding the narrow strip across the log paper, the best matching of prototype and wire stiffnesses can be quickly chosen.

FIG. 7. Effect of stiffeners is shown on graph.



Lack of roundness in brazing and welding rod can often be used to advantage by rotating the wire to provide the exact stiffness required. This can be accented by draw-filing two opposing flats on the wires. But the best control can be achieved by soldered stiffener plates. The relation between bare and stiffened brass wire is shown in Fig. 7. Note that a difference in the size of the wire and a variation in the number of stiffeners has little effect on the relation, which is a straight line on log-log paper. Individual variations in soldering technique require each investigator to construct his own Fig. 7.

Making the model

Cut the selected wires to length and tape them in proper position on the asbestos-cement board. Slide gusset, reaction, and stiffener plates under the wires, apply acid and solder. Plenty of strength is developed with only 0.2 in. of each wire enclosed within the solder. Build joints to correspond to the prototype by making large gussets to represent massive joints and by using small gussets to represent compact joints. Haunches must be represented by using stiffeners.

Compute the moment of inertia at intervals and compute the required length of stiffener at each interval using the curve of Fig. 7. Use a No. 58 drill in reaction plates for push-pins. File the under side of the model smooth to reduce friction on the drawing paper. For precise results, support the model on glass plates (double-depression microscope slides are ideal) separated by $\frac{1}{8}$-in. steel balls.

Reaction plate

At pinned supports only one hole (located at the end of the member) is needed in the reaction plate because free rotation must be assured at all times. For fixed reactions, drill two holes about two inches apart. Rotation must be entirely prevented except for displacement to find moment. Partially fixed supports can be represented by extending the wire from the primary support (where it is pin-supported) to a secondary support (where it is also pin-supported), distant enough to provide the proper elastic restraint.

When equal and opposite displacements are to be used, it is unnecessary to trace or to record the neutral position of the model. Produce one displacement, trace the model (marking the load points), produce the other displacement, and retrace the model (also marking the load points). Ordinates are measured *between corresponding load points* and parallel to the loads. Reactions, too, must always be applied to the same point on the wire. With continuous beams, this means that it may be necessary to shift the supports slightly. If there are several loading conditions, it usually saves time to convert each elastic curve into two influence lines—one for vertical loads and one for horizontal loads—and to replot them on graph paper. Models supported on glass balls cannot be traced. Instead, targets must be glued at load points and the movement of the targets measured directly.

Uniform loads can be approximated by a series of concentrated loads. Divide the span into at least four equal parts. Concentrate the load at the center of each part. If great accuracy is wanted, divide the span into six, eight, or even ten equal parts.

Signs of reactive or internal forces are determined by the following rule: The work of the unit deformation must always be opposite to the work of the applied load. In Fig. 1, for example, the work of P is positive because the load moves in the direction applied. Therefore the work of R must be negative, and R must act opposite to the movement. That is, R must act to the right.

Sources of errors

The most important and devastating source of errors is friction, and it must be essentially eliminated at all costs. This can usually be done by pushing the wire first to one side, then to the other—over and over again—each time tapping or otherwise vibrating the board till the model comes to rest. Then the model can be set in its mean position for tracing the elastic curve. Tall rigid frames and models heavy with stiffener plates cannot be traced and must be supported on steel balls.

Errors in measurement can be reduced only by extreme care. With a scale divided into 100 parts per inch and a magnifying glass, it is possible to measure to the nearest 0.002 in. But for such accuracy to be significant, other techniques (such as the elimination of friction, parallax, etc.) must be appropriately refined.

Avoid parallax in tracing influence lines by keeping the pen in a vertical plane. Hold the pen very loosely by the extreme top of its handle so that it will not displace the wire. Draw the finest possible lines. For the ultimate in accuracy, do not try to trace influence lines. Instead, read the deflection of targets glued to the model. Always mount the targets so that the scale can actually touch them.

Large displacements do cause geometrical distortion and consequent error but these errors have been overrated in the literature. For example, in a two-span continuous beam, the maximum experimental error for a deformation at an outside reaction of one-quarter of the span length (made in one direction only) was less than 2 percent. The error due to all causes did not exceed 5 percent even when the imposed deformation was equal to half the span. Equal and opposite deformations of the magnitude imposed by the Sanks deformeter do not produce large errors in rigid frames or continuous beams. Flat arches may require deformation angles of less than one-half a radian, and this can be done as shown in Fig. 4 (*d*).

The physical size of the deformeter and of the soldered joints causes error because the wire enclosed within the deformeter or joint is almost infinitely rigid. Fortunately, the errors produced are not excessive provided not more than 5 or 6 percent of the span length of a member is so enclosed. This means that any member which is to be held in a deformeter should be not much less than 10 in. long. However, the error due to enclosure increases the deflections while that due to the geometrical distortion decreases the deflections; hence the errors tend to compensate.

In spite of the ominous sound of errors, the accuracy that can be obtained with such simple equipment is excellent. With care, errors should not exceed 5 percent and will often be less that 2 percent. Anyone who has compared computed strains with measured strains in actual structures knows that such errors are insignificant. Accuracy with wire models is the reward of skill, delicacy, and an appreciation of adverse factors. A modicum of practice is necessary as with any skill.

Accuracy is excellent

As an example of the accuracy and rapidity of the wire-model method, the writer analyzed the rigid frame of Fig. 8. The model was made of No. 49 and No. 52 brass drill-rods. Stiffness was varied at haunches by the use of stiffener plates as shown in Fig. 5. A period of about 3½ hours was required to calibrate the wires, cut and solder the stiffener and gusset plates, glue the targets, and mount the model. It required about 45 minutes to manipulate the model, read and check the ten targets, and reduce the readings to net moment. Thus the entire analysis was completed from start to finish in about 6½ hours. A solution by moment distribution takes (the writer, at least) much longer and is more susceptible to blunders. A comparison of a moment distribution solution and a model made to represent that particular solution yields the following:

	Moments in kip-ft		
Moment at	By model	By moment distribution	Discrepancy, %
A	159.7	156.6	2.0
B	89.9	92.5	2.8
C	92.1	88.2	4.4
D	245.0	249.6	1.9

This rigid frame is very sensitive to slight changes in its haunches. Two different analyses for the same rigid frame in which the assumptions of conversion of circular to parabolic haunches (to fit the *Handbook of Frame Constants*) [8] varied only slightly, showed discrepancies of 2.0, 5.3, 11.4, and 4.8 percent at points A, B, C, and D respectively. Thus a model built to represent the circular haunches of Fig. 8 would very likely provide a more accurate solution than one by moment distribution in which constants for "equivalent" *parabolic* haunches would be used.

Wire models can be made satisfactorily out of locally available and inexpensive materials and are well suited to office use. Except for a simple, inexpensive deformeter, no special apparatus is needed. Partially fixed supports, haunched and tapered members can be easily represented. Wire models can often be constructed more quickly and easily than any other type and can be tested at least as quickly as other types. The speed and accuracy of the wire-model method, coupled with the fact that there is less chance of blunders, make it competitive with—and often superior to—the best of the well-known analytical methods.

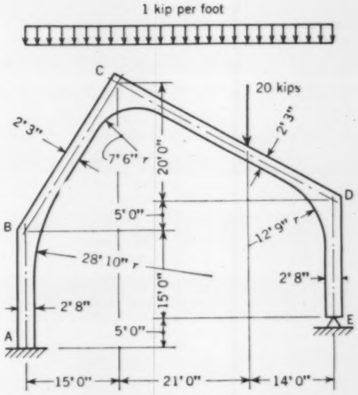


FIG. 8. Gabled rigid frame is analyzed by author to illustrate accuracy and rapidity of wire-model method.

Acknowledgment

This article is based on parts of the forthcoming book by R. L. Sanks, *Theory of Statically Indeterminate Structural Analysis*, to be published by the Ronald Press Company.

References

[1] George E. Beggs, M. ASCE, "An Accurate Mechanical Solution of Statically Indeterminate Structures by the Use of Paper Models and Special Gages," *Proceedings*, American Concrete Institute, vol. 18, 1922, pp. 58-82.

[2] Sold by Soiltest, Inc., 4711 West North Ave., Chicago, Ill.

[3] Obtainable from Prof. W. J. Eney, F. ASCE, Fritz Engineering Laboratory, Lehigh University, Bethlehem, Pa.

[4] W. J. Eney, F. ASCE, "A Large Displacement Deformeter Apparatus for Stress Analysis with Elastic Models," *Proceedings*, Society for Experimental Stress Analysis, vol. VI, no. II, pp. 84-93.

[5] Anders Bull, F. ASCE, "Brass Wire Models Used to Solve Indeterminate Structures," *Engineering News-Record*, vol. 99, 1927, pp. 920-922.

[6] Available in small lots from T. E. Conklin Brass & Copper Co., Inc., 54-60 Lafayette St., New York 13, N. Y.

[7] Both obtainable from United Welding Service Co., Box 564, Franklin, Penna.

[8] *Handbook of Frame Constants*, Portland Cement Association, 33 West Grand Ave., Chicago 10, Ill.

Montage of a few structures in the St. Lawrence Project shows Eisenhower Lock (lower left) and Iroquois Lock (upper right), with Moses-Saunders Power Dam in foreground.

St. Lawrence Project wins ASCE achievement award

The St. Lawrence Project, involving the power and seaway developments on the United States and Canadian sides of the St. Lawrence River, was named the outstanding civil engineering achievement of the year at the closing session of the New Orleans Convention.

The ASCE Board of Direction officially confirmed the selection of a jury of engineering magazine editors, which had picked the St. Lawrence Project for the 1960 civil engineering achievement award.

It is the first award to be made by the Society in an annual series recently established to recognize an achievement in civil engineering. In 1955 the Society honored seven outstanding existing civil engineering works by citing them as "modern civil engineering wonders of the United States."

The St. Lawrence Project was one of twelve nominations made for the current award from all parts of the country, involving all types of engineering developments. Actually, the citation is directed toward the four agencies involved in the St. Lawrence Project, the power and seaway projects on both sides of the river. These are the Power Authority of the State of New York, the St. Lawrence Seaway Development Corporation (USA), the Hydro-Electric Power Commission of Ontario, and the St. Lawrence Seaway Authority (Canada).

Each of these agencies will receive an appropriate plaque from ASCE at ceremonies to be held at Massena, N. Y., on May 19. Representatives of both Canada and the United States will participate. The ceremonies will be held on the power dam between the United States and Canada, shown in the accompanying montage.

Nominations, made by the Directors of the Society in their respective Districts throughout the country, were judged in three categories: (1) whether the project demonstrated improved skill in civil engineering; (2) whether the project contributed to engineering progress, and (3) the project's value to mankind. The St. Lawrence Project, which was nominated by District 3, scored high in all categories.

Special Honorable Mention was given to the Allegheny County Sewage Disposal System, the choice of District 6. This $100 million facility serves the city of Pittsburgh and 69 surrounding communities.

The Allegheny County Sewage Disposal System and the other nominations for the 1960 Outstanding Civil Engineering Achievement Award were described and pictured in the February issue (page 44).

Editors comprising the Jury of Award were: William S. Foster, *American City;* Hal Hunt, CIVIL ENGINEERING; Henry Perez, *Construction Methods;* William Quirk, *Contractors and Engineers;* Waldo G. Bowman, *Engineering News-Record;* W. A. Hardenbergh, *Public Works;* Harold J. McKeever, *Roads and Streets;* James I. Ballard, *Western Construction.* Mr. Hunt was chairman.

Vehicular Tube in San Francisco Bay

PAUL E. PARKER, Senior Bridge Engineer, California Division of Highways, Sacramento, Calif.

Construction of a $17,000,000 vehicular tube under the Oakland Estuary in San Francisco Bay began in October 1959. Work will extend over a three-year period. The new tunnel, at present known as the Webster Street Tube, will be parallel to and about 500 ft to the west of the existing Posey Tube, which was completed in 1928. With the completion of the new facility, each tube will carry two lanes of one-way traffic, and a serious traffic bottleneck between the cities of Oakland and Alameda will be eliminated.

The project consists of a "boat-section" approach in both Oakland and Alameda, a "portal building" at each end of the crossing for ventilation and electrical equipment, twelve precast tube segments each 200 ft long, a cast-in-place section 783 ft long, three temporary bridges, one permanent bridge, waterfront and street work, and extensive mechanical and electrical work and equipment. The contract amount is $16,641,000 and the contractors are Pomeroy, Bates & Rogers, Gerwick—a joint venture.

Geology of the site

The geologic formations at the site (Fig. 1) consist of a shallow layer of recent fill underlain by a soft marine clay (bay mud), interbedded marine and continental sediment and, at depths greater than 200 ft, by rock. Very little if any structural support can be obtained from the fill or bay mud.

Measured void ratios of the marine and continental sediments indicate that they once were subjected to loads of greater than normal magnitude, which consolidated them sufficiently for the support of moderate foundation loads. Bearing for the major part of the tube will be on these materials.

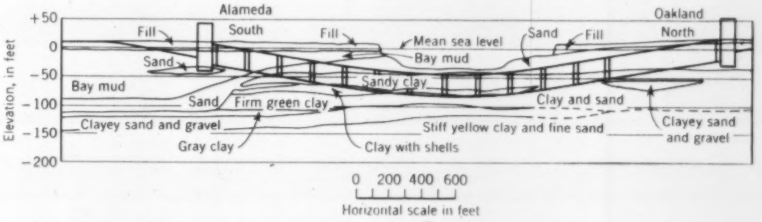
Since the tube is located between the San Andreas fault zone in San Francisco and the Hayward fault zone at the base of the Berkeley Hills, it will be subject to frequent earth shocks varying in intensity from mild to severe.

The portal buildings lie astride the tunnel at each end and are located so that the top of the entering tunnel is nearly at ground grade. This arrangement resulted from a consideration of relative costs of approach, portal-building foundation, tunnel section and ventilation increments. Tunnel grades are limited to 4.75 percent downgrade and 4.5 percent upgrade. Minimum clearance between pierhead lines is 40 ft below mean lower low water. Minimum protective cover on top of the tunnel is 5 ft. These controls result in a tunnel length of 3,350 ft between portals (Fig. 2).

The tunnel roadway width is 24 ft between curbs; the minimum vertical clearance is 15 ft. A raised walkway 3 ft wide serves pedestrians and maintenance personnel.

Precast part of tunnel

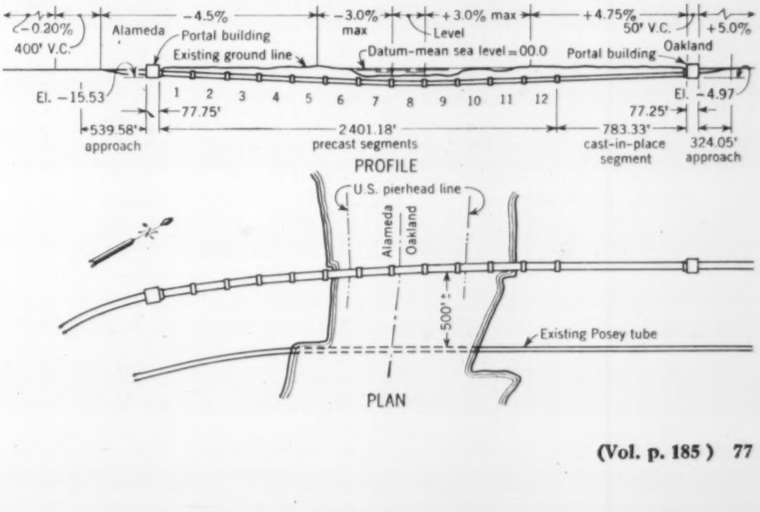
The precast part of the tunnel (Fig. 3) will be constructed by the trench method. The sections are circular in cross-section with an outside diameter of 37 ft and a shell thickness of 2 ft 6 in. They are constructed entirely of reinforced concrete. The ends have rectangular collars to facilitate placing and joining. Although the precast part of the tunnel has a slight curvature in plan (R=30,000 ft) and a profile re-



+50
0
−50
−100
−150
−200
Elevation, in feet
Alameda
South
Oakland
North
Fill
Fill
Sand
Fill
Mean sea level
Bay mud
Sand
Bay mud
Sandy clay
Sand
Firm green clay
Clay and sand
Clayey sand and gravel
Stiff yellow clay and fine sand
Clayey sand and gravel
Gray clay
Clay with shells
0 200 400 600
Horizontal scale in feet

FIG. 1. Geologic formations at the site of the Webster Street Tube consist of a shallow layer of recent fill underlain by a soft marine clay, interbedded sediment and, at depths greater than 200 ft, by rock.

FIG. 2. The new tube will run parallel to the existing Posey Tube about 500 ft away. The total length of the tunnel between portals will be 3,350 ft.



−0.20%
400' V.C.
−4.5%
−3.0% max
+3.0% max
Level
+4.75%
50' V.C.
+5.0%
Alameda
Portal building
Existing ground line
Datum-mean sea level = 00.0
Portal building
Oakland
El. −15.53
1 2 3 4 5 6 7 8 9 10 11 12
77.75'
El. −4.97
77.25'
539.58' approach
2401.18' precast segments
783.33' cast-in-place segment
324.05' approach
PROFILE
U.S. pierhead line
Alameda
Oakland
500'±
Existing Posey tube
PLAN

In retouched aerial view, existing Posey Tube is at right, new tube is at left. Approaches and portal buildings are shown as they will appear when completed.

sembling a sag vertical curve, the sections are constructed straight in both directions. The bottoms of the collars are level and the collar faces vertical in all cases.

It is planned to construct the tube shell, collars and roadway slab in a dry dock or construction basin and to complete the interior after placing in final position. The dry-dock weight of one section is approximately 5,500 tons. This includes a temporary watertight bulkhead at each end, which consists of a calked timber planking face supported by steel wide-flange shapes. The draft when floated will be approximately 30 ft. In order to sink a section at the site, it will be necessary to add at least 1,600 tons of ballast. This can be done by filling the space beneath the roadway slab with water and placing sand or other material on the roadway slab.

Sections undoubtedly will be lowered by floating derrick barges with breast lines to temporary dolphins. Sections will probably be ballasted until they have a negative buoyancy of 200 to 300 tons, and the derricks must be capable of supporting this weight.

On the outside the tube barrel will be covered with three-ply membrane waterproofing. This waterproofing will be covered with 2-in. timber planking to protect it during placing and backfilling. In placing the sections, one end will be supported on the preceding section by means of two "coupler" beams at the top of the section being placed. The other end will rest on six pipe piles of 12-in. diameter that have been cut off accurately to proper grade. These six piles will provide temporary support for the section. Two of them will act as positioning piles and must be set accurately to line. These positioning piles will fit into sockets embedded in the bottom of the collars, an arrangement intended to reduce the problem of matching the ends of adjacent sections in case of twist or differences in line or grade. At the same time it will ensure correct spacing between sections. The contract permits the contractor to use alternative methods for coupling and positioning the segments, subject to approval by the engineer.

Aligning masts will be erected at each end of each section and will be high enough to project above the water when the section is in final position. This will permit the location of the section to be accurately determined at all times during the sinking operation by usual survey methods.

A rubber ring 39 ft 3 in. in diameter projects from the section at the end containing the coupler beams. This ring fits over a tapered circular concrete projection on the preceding section to provide a seal for the placement of tremie concrete about the entire joint. Each section is lowered into position in such fashion that its longitudinal axis makes a slight upward angle with its final location. In this position the coupler beams are seated on the preceding section and the rubber sealing ring engages the upper part of the tapered joint. The action of lowering the far end to final position on the piles forces the rubber ring about the remainder of the tapered joint. A thin metal semicircular form is placed on both sides of the collars at the joint to contain the tremie concrete (Fig. 4).

After the tunnel sections are placed, sand is sluiced or jetted under and around them to at least 7 ft above the bottom of the tube barrel. Sufficient additional ballast is then added to the

FIG. 3. Twelve precast reinforced-concrete tube segments, each 200 ft long, comprise about three-quarters of the tunnel length. The sections are circular in cross-section with an outside diameter of 37 ft and a shell thickness of 2 ft 6 in.

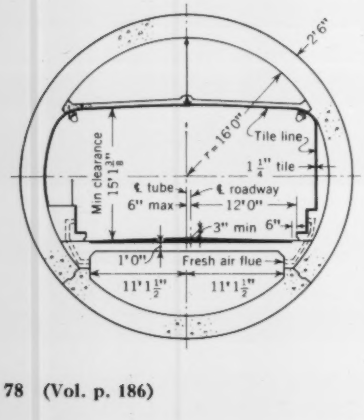
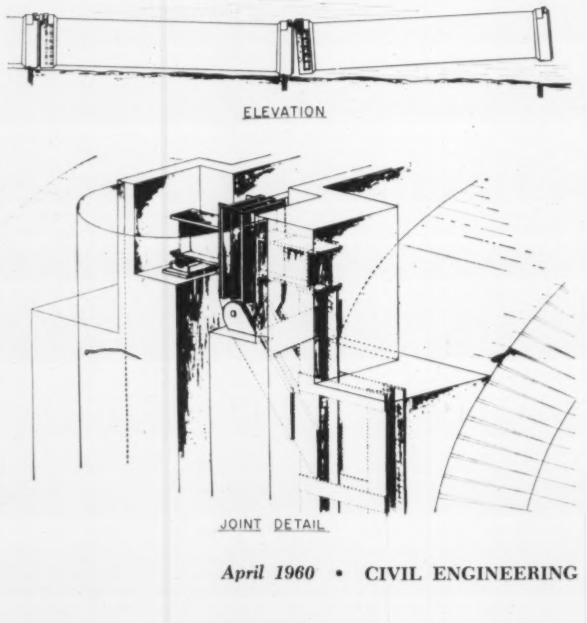


FIG. 4. Two coupler beams on the section being placed aid in positioning it on the preceding section. The action of lowering the far end of the section to final position on the piles forces a rubber ring around the tapered joint. A thin metal semicircular form is placed on both sides of the collars at the joint to contain the tremie concrete.



sections to cause settlement of the temporary support piles and transfer of weight to the sand bed. The piles are friction piles in all cases and their lengths are calculated from soil data to accord with the selected failure load. The amount of pile settlement is estimated and allowance made in initial pile cutoff grades. The tremie concrete seal is placed around the joints between tube sections after the sections on both sides have been bedded in the sand. Backfilling is completed after the joints are sealed.

Heavy concrete and fill

To increase the factor of safety against flotation, the specified minimum weight of the tunnel concrete in the channel area has been increased from 147 lb per cu ft to 152 lb per cu ft, exclusive of reinforcement. The backfill cover in this area is of minimum depth. Concrete made from any of several local aggregate sources will meet this higher weight specification.

Including the weight of backfill material directly above the tube, with no allowance for frictional forces, the minimum factor of safety of the tube against flotation is 1.25.

A blanket of heavyweight backfill has been specified in the channel area to lessen the possibility of scour and resulting lowering of the factor of safety. The heavyweight backfill is a graded material, of 3-in. sieve size and smaller, having a specific gravity of 4.35. Iron ores of relatively low grade are available in northern California with at least this specific gravity.

The precast tunnel will begin at the Alameda Portal Building, which is located about 1,000 ft from the edge of the estuary. Land use in this area is such that right-of-way costs for trench construction are not high. On the Oakland side, however, right-of-way costs in the region of the tunnel are relatively high. For this reason, the precast part of the tube is not carried beyond First Street in Oakland although it is theoretically possible to float sections nearly 600 ft further.

A tremie-concrete platform with a concrete-pile foundation is used to contain the bedding sand and provide support for the first precast section at the Alameda Portal Building. The material along the tunnel bottom in this area is bay mud and this special support is necessary to ensure that there will be no ultimate movement of this tunnel section. A special support was used under similar conditions in the construction of the Posey Tube and has proved entirely satisfactory.

Beyond First Street in Oakland the tunnel will be constructed in place in a trench 47 ft wide. This trench varies in depth from 72 ft at First Street to 45 ft at the Oakland Portal Building. The outer surface of the tunnel cross-section has been made horseshoe shaped for this portion to simplify the placing of formwork and concrete (Fig. 5). The exterior surface, including the bottom, is covered with three-ply membrane waterproofing. Transverse construction joints are specified at a maximum spacing of 220 ft to minimize shrinkage cracking.

Three Southern Pacific Company tracks at First Street, and one Western Pacific Railroad track at Third Street, are to be carried across the tunnel trench on temporary bridges. In addition, a 105-in. interceptor sewer at First Street and a 48-in. combined sewer at Second Street are also to be supported temporarily across the trench during tunnel construction.

"Transverse" ventilation system

The tunnel will be ventilated using the "transverse" system (Fig. 6). The area under the roadway slab is utilized as a fresh-air duct and the area above the ceiling slab as an exhaust-air duct. Air in the fresh-air duct is forced through flues on either side of the roadway and near roadway level. These flues are 3 ft long, 6 in. high and are spaced approximately 9 ft on centers. A sliding-plate arrangement makes it possible to regulate air flow. Exhaust-air ports are located in the ceiling slab. These ports are 6 ft 9 in. long by 12 in. wide and are spaced in pairs 15 ft 6 in. on centers. They also have sliding plates to regulate air flow.

Each portal building houses four exhaust fans and four blower fans. The fans are the vane-axial type with a nominal diameter of 84 in. and have, in general, a capacity of 115,000 cfm at a pressure of 1.35 in. of water. Eight different stages of ventilation are provided for varying traffic densities.

Transverse walls in both the fresh-air and the exhaust-air duct divide the tunnel ventilation into two parts. These walls are placed nearer the Alameda end, from the center of the tunnel, in order to provide larger air quantities for the up-grade portion of the tunnel.

Fresh air is drawn through large louvered areas on the sides of the portal buildings and exhausted through evasé stacks, which project through the roofs of the portal buildings. Ventilation levels are controlled either manually or automatically. The automatic controls are linked to traffic density by means of an "evaluator," which maintains a continuous record of vehicles actually in the tunnel.

Air requirements used for ventilation design were based on an estimated maximum tunnel capacity of 1,800 vehicles per lane per hour. A carbon monoxide analyzer in each of the portal buildings will maintain a continuous record of carbon monoxide content. All controls will be placed in the Oakland Portal Building of the existing Posey Tube so that both tubes can be operated from one central location.

Each portal building will have a separate high-voltage system supplied by different power sources. Each system will be capable of supplying all tunnel power needs. Power will normally be taken from one source but a tie cable

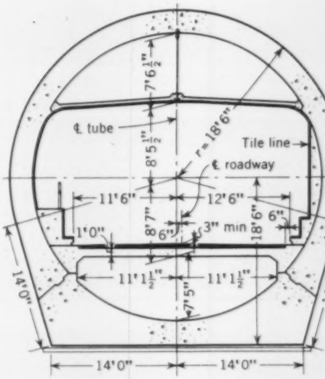
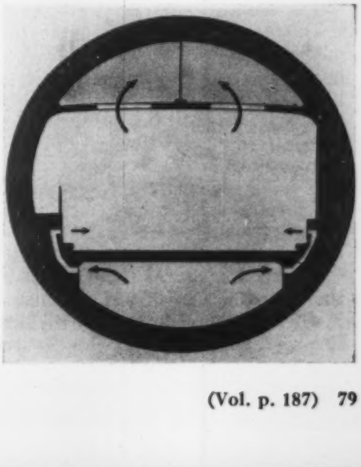


FIG. 5. About 780 ft of the tunnel at the Oakland end will be cast in place in a trench 47 ft wide. The outer surface of the tunnel cross-section has been made horseshoe shaped for the cast-in-place section, to simplify placing of formwork and concrete.

FIG. 6. Ventilation of the tunnel will be accomplished by using the transverse system. The area under the roadway slab is utilized as a fresh-air duct and the area above the ceiling slab for exhaust air.



running through the tunnel and connecting each system will permit automatic changeover in the event of a power failure.

The tunnel will be lighted by two continuous rows of fluorescent lights. The fixtures are of special design for ease of maintenance and for sealing against the large amounts of dirt found in tunnels and against the high-pressure water spray used in tunnel cleaning. Unique in tunnel lighting is the system which provides a lower-wall daytime brightness of 30 to 60 footlamberts in the 300-ft-long "entrance zone," 5 to 10 fL in the "central zone," and nighttime lower-wall brightness of ½ to 1 fL. A day-to-night dimming ratio up to 60:1 may be obtained without interruption of the continuous line of light.

Interior of tunnel

The tunnel ceiling and the walls down to the tops of the curbs will be lined with ceramic tile. The tiles will be 4¼-in. x 4¼-in. x ⅜-in. size excepf below the walkway level where they will be 6 in. wide to conform with the size of the fresh-air flue. All tile will have projecting lugs or keys on the back surface for mechanical bond. The tile finish will be glossy to facilitate cleaning. A pale green shade has been specified for the smaller tile and a slightly darker green for the 6-in. size. This color was chosen for maximum visibility, psychological effect, and appearance.

The roadway is designed as a simply supported slab. Live-load moments were determined for an H20-S16 truck load in each lane. The wearing surface is bituminous concrete.

Roadway drains are located at the portals to intercept approach drainage and at the middle of the tunnel, where washdown water and seepage will be collected.

Water for fire protection is supplied by a pipe of 4-in. diameter on each side of the tunnel, with hose connections every 200 ft. There is an emergency station with a fire alarm and telephone every 200 ft along the walkway side of the tunnel.

Tube stresses were computed by conventional methods for the analysis of closed rings employing semigraphical integration. Loadings peculiar to construction and placing as well as those in the final position were considered. Variations in final loadings due to differences in depth were accounted for by dividing the tunnel into 200-ft lengths.

The project was designed by the California Division of Highways under the direction of F. W. Panhorst, F. ASCE, Assistant State Highway Engineer, Bridges.

ENGINEERS' NOTEBOOK

Streamlines in a

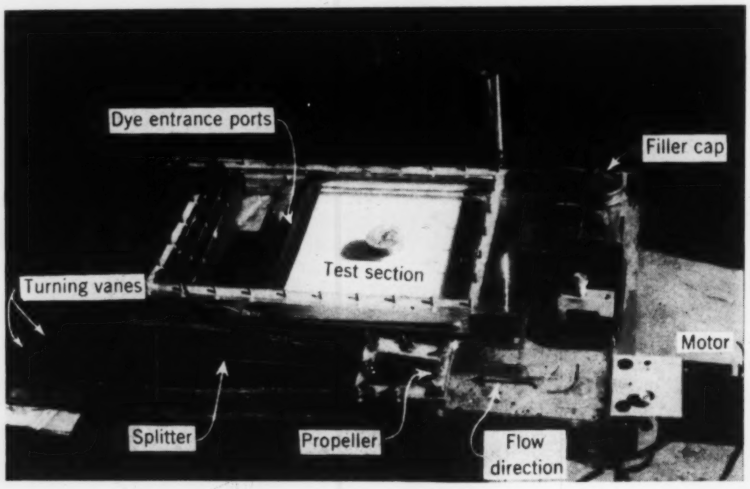
A small lucite water tunnel that shows streamline patterns formed by a fluid flowing either through conduits or around various geometrical shapes has been developed at the University of Texas. This relatively small and compact unit serves as an instructional aid to illustrate the principles of fluid kinematics in a basic fluid mechanics course. The apparatus has three main parts—a test section, a recirculating system, and a motor-driven propeller. With the test section in a horizontal position, a graphical presentation of potential flow, stagnation points, separation zones, and turbulent wakes can be obtained. If the test section is operated in a vertical position, some free-surface phenomena such as flow over weirs or flow under sluice gates can also be observed.

The test section, in which streamlines are illustrated with dyes, can be placed over the stage of a Vu Graph or other overhead-type projector. The flow patterns can thus be projected on a screen for classroom viewing. It is not convenient, however, to project free-surface patterns on a screen as the stage of a Vu Graph projector is not readily adaptable to vertical positions. Although this water tunnel was primarily designed as a demonstration apparatus, it could be used, after some minor modifications, for student laboratory exercises or quantitative measurements.

The apparatus, shown in Fig. 1, is mostly of lucite, with turning vanes, drive shaft, and propeller of brass. The thickness of the flow passage is 1½ in. except in the test section (10 in. wide by 12 in. long) where the thickness is reduced to ½ in. The plan dimensions for the test section were chosen to coincide with the projection-stage dimensions of an available Vu Graph projector. The lower boundary of the approach to the test section is elliptical in shape so as to reduce the thickness of the flow with minimum disturbance.

Included within the forward part of the test section is a manifold with nine evenly spaced openings through which dye is injected into the stream. As the dye openings in the test section are very small, it is essential that nonclogging dyes be used. Methylene blue and Methylene violet have been found satisfactory. These dark organic dyes project clearly on a screen. Although the water in the tunnel becomes colored with dye after a long period of use, the apparatus has been operated continuously for six hours without changing

FIG. 1. Small lucite water tunnel includes parts shown.



lucite water tunnel

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Associate, Division of Hydraulic and Sanitary Engineering

The University of California, Berkeley

the water. At the end of this time, the projected streamline patterns were still easily distinguishable.

The propeller that recirculates the fluid is driven by a constant-speed motor. Variations in speed are obtained by means of a brake, which is in contact with the coupling between the motor and the drive shaft. The return passage is constricted to accommodate the propeller, and then expanded by a diverging section which includes a brass splitter. The splitter reduces the angle of divergence and lessens the possibility that separation from the walls of the tunnel will occur in this part of the flow passage.

To illustrate potential flow, the depth in the test section should be very shallow so that the flow can occur as a boundary layer. An analysis of laminar boundary-layer flow by means of the Navier-Stokes equations indicates that there is no rotational component about an axis normal to the plane of the test section. Figure 2, which illustrates potential flow around a circular cylinder, was obtained by operating the unit with a thin film of water moving through the test section at a very low velocity. The flow pattern in this case was irrotational and the apparatus may be considered as operating essentially in the same way as Hele-Shaw plates.

Potential flow around a flat plate is illustrated in Fig. 3. If the angle of attack of the plate is changed, the corresponding shift in the location of the stagnation point can be readily observed.

If the full thickness of flow in the test section is utilized, this water tunnel is particularly useful to illustrate separation zones and turbulent wakes. With moderate care, it is possible to show the development of the vortex trail that forms in the wake behind circular cylinders.

An interesting point to be noted in Fig. 4, which illustrates turbulent flow around a cylinder, is the location of the apparent stagnation point. It has been found that as the velocity of flow is increased, the apparent stagnation point moves forward of the leading element of the cylinder and actually is situated out in the stream. This position can be explained in terms of the secondary flows that develop around a cylinder when it is located in a stream having non-uniform velocity variation with depth.

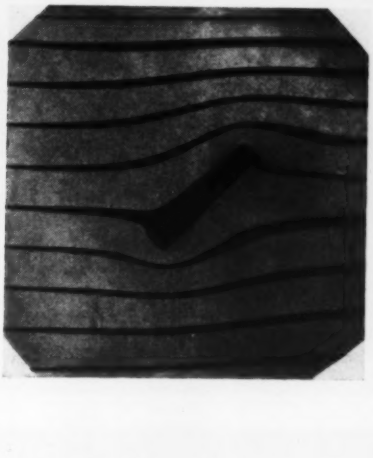
Under the influence of the velocity gradient in the boundary layer of the approaching flow, there is a downward flow along the leading element of the cylinder. This downward flow sustains a vortex that wraps itself around the bottom of the cylinder, producing velocities directed away from the cylinder at its base. This secondary flow opposes the oncoming flow in the thin layer of fluid carrying the dye streak and shifts the apparent stagnation point away from the cylinder. The dye streak may be thought of as moving around the virtual boundary formed by the outer surface of a ring vortex at the base of the cylinder. The onset of instability in the wake is also evident in Fig. 4.

If the dye is introduced higher up in the approaching flow, instead of at the lower boundary, this apparent shift in the stagnation point will not occur.

Walter L. Moore, Professor of Civil Engineering at the University of Texas, conceived the idea of the apparatus here described. It was designed and detailed by the writer. The initial cost of materials, including the lucite and the motor, was about $50. Construction costs were kept to a minimum by fabricating the unit in the Civil Engineering Department's shop at the University of Texas.

FIG. 2. Pattern of potential flow around a circular cylinder (from left to right) was obtained by operating the unit with a thin film of water moving through the test section at a very low velocity.

FIG. 3. In potential flow around a flat plate (from left to right), change in angle of attack of plate immediately produces corresponding shift in location of stagnation point.



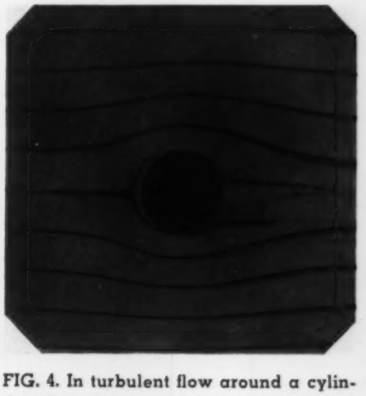


FIG. 4. In turbulent flow around a cylinder (from left to right), it is interesting to note the location of the apparent stagnation point. As flow velocity increases, stagnation point moves forward of the leading element of the cylinder.

THE READERS WRITE

The engineer his own worst enemy in regard to status

To the Editor: Many of the comments of E. R. Harrington, M. ASCE, in his article, "Engineers, Atomic Physics, and Mathematics" (February 1960, vol. p. 78), strike at the very heart of the matter. After reading many articles on this subject, I have reached the same conclusion—that the engineer is his own worst enemy in regard to status.

Many in the engineering profession state that a man is not an engineer unless he uses advanced mathematics in every problem and meets previously unsolved problems each day. These writers constantly use as perfect examples the medical and legal professions. Someone is rather naive here. Any practicing engineer, particularly a civil engineer, finds out very soon that many, if not most, practical problems have no rigorous mathematical solution. There are simply too many assumptions and uncertain factors.

So far as the medical profession is concerned, I wonder if a doctor prescribing aspirin for a minor cold or bandaging a cut finger would be classified as a medical technician? Also, is a lawyer who prepares a minor will or makes a title search for a family dwelling a legal technician? By no means can it be said that these problems are previously unsolved ones. I can assure you that the doctor and the lawyer would state at once that they are professional men regardless of the minor work being done.

It is simply a matter of having self-respect and pride in one's work. The engineer should feel that he knows as much about his work as the doctor and the lawyer know about theirs. Some routine problems enter all professions.

Unfortunately some of this same uncertainty has entered engineering education. Many feel that our present system must be revised completely, even to the extent of eliminating engineering drawing, surveying, and most laboratory courses to make room for more mathematics and science. Of course all curricula will undergo changes as time goes on. Some engineers will have to be educated more as engineering scientists than as engineers in order to solve problems in specialized fields. Also, more men are now continuing to graduate school. Yet is our present system so unacceptable considering the fine engineering work that has been and is being done by its graduates?

L. K. Himelright, Lt. Col., F. ASCE
Head, Dept. of Civil Engineering
The Citadel

Charleston, S. C.

Surveyor or surveyman? An important distinction

To the Editor: In "The Younger Viewpoint," vol. p. 124 of your February issue, the heading "Unions for Surveyors?" should more appropriately read "Unions for Surveymen?" This would be in tune with the subject, which relates to party chiefs, instrumentmen and rodmen.

The point is important in assisting the public to recognize the difference between professionals, technicians, and aids, be it in surveying or in engineering in general.

In a recent case reported in the newspapers, a TV firm using "engineer" in its company name was fined under a law prohibiting the use of this term unless applied to professional engineers. Conviction was under a law passed "to keep the value of the word 'engineer' for professional engineers."

We can all help in keeping the value of the word "surveyor" for the professional and not use it when we mean "surveyman."

If our younger engineers begin to recognize this important distinction, it stands a fair chance of being understood by other professionals and by the lay public—and perhaps by the surveymen and the unions—as well as by the surveyors.

W. S. Dix, F. ASCE
Executive Secretary
American Congress on Surveying and Mapping

Washington, D. C.

"Computer designs steel . . ."

To the Editor: We were very much interested to read, in your June 1959 issue (vol. p. 414), the article by John H. Wells, F. ASCE, "Computer Designs Steel . . . a Floor at a Time," because we had applied an electronic digital computer to the same design problem.

We find close agreement between our approach and the one described by Mr. Wells. We would like to endorse most strongly the advantages claimed for using a computer—indeed we have obtained even greater savings in time. Our computer is a Ferranti Pegasus I, which has 4,000 words of drum storage and 55 immediate-access registers. Input and output are by five-channel punched tape.

As in your program, we use a data tape containing the necessary constants for each rolled section available to the designer. Similarly also, our program tries each available section in turn, beginning with the lightest, until one is found that satisfies each design criterion.

Where our own program differs most significantly is in the form of input data to specify the particular floor to be designed. We identify each joint or other relevant position simply by reference to a rectangular grid, that is, by a pair of integers. The grid has just enough lines to fix every beam, point load, area loading, etc.; its dimensions (which can be quite irregular) form part of the data. Linear loadings and area loadings are input simply by their amounts, and grid positions. The program scans the loaded areas thus specified and itself determines the resulting linear loadings. Floors that are too large for present computer capacity can be handled by using a partitioning technique.

We also have a program, entirely separate, for designing columns. Later on we hope to extend the storage of our computer. This will make possible more ambitious programs, such as the design of rigid frames without restriction on account of size.

We would like to record the encouragement we have derived from knowing that others are reaching similar results in this field.

M. B. Card
Senior Computer Officer
The United Steel Companies Ltd.

Sheffield, England

Errors corrected

To the Editor: The interesting article by Vernon E. Swanson, F. ASCE, "Extra-Large Bars for Reinforced Concrete Columns," in the February issue (vol. p. 118), carried several errors in the final paragraph.

The column bars should have been designated as Nos. 14 S and 18 S, rather than 145 and 185, and the credit to the general contractor for this work should have gone to A. L. Jackson Company, rather than to Sherman Olson, Corp. (Sherman Olson, Inc.).

Norman F. Brunkow, F. ASCE
Chief Structural Engineer
Graham, Anderson, Probst & White

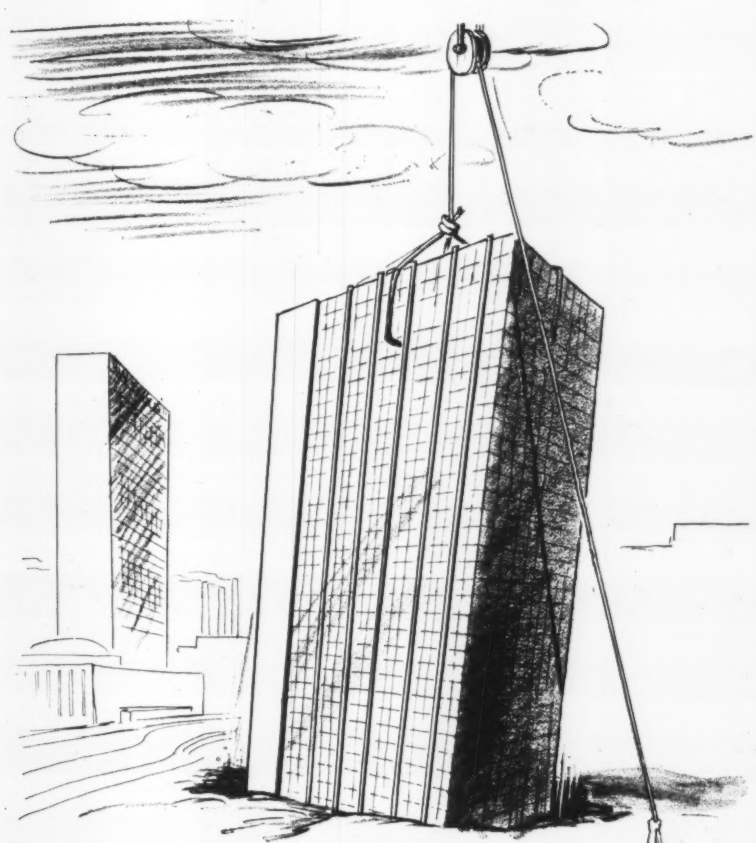
Chicago, Ill.

UEC Fund Campaign to Be Concluded by June

Although the ASCE campaign for funds for the United Engineering Center will continue until the $800,000 quota is met, the Board of Direction of the Society, meeting at New Orleans, decided to make an all-out drive to complete the campaign by June. In reviewing individually the prospects for the Sections who have not yet reached their quotas, the Directors, in almost every case, expressed their belief that the goal would be reached in the stipulated time.

There are some interesting statistics to report.

- The Metropolitan Section is farthest over its goal—by the amount of $16,000.
- The Southern Idaho Section is over its quota by 100 percent.
- The Tri-City Section is tops in number of contributors—96 percent of the number of members in the Section when quotas were established—and the Section is 14 percent over its goal.
- Ten Sections have secured contributions from more than 60 percent of their members. All are over their quotas.
- Some 23 additional Sections have contributions from more than 40 percent of their members. Fifteen of these have filled their quota. With two notable exceptions the rest are within striking distance.
- Thirty-five Sections are now on the UEC Honor Roll. The newcomers to the list are the Duluth and Virginia Sections.



Look what one out of three ASCE members has done! This small group has pulled ASCE financing of the UEC to more than 90 percent of its planned goal. Lend a hand to finish the campaign! Our thanks to "Electrical Engineering" for the illustration.

UEC HONOR ROLL

Once again Civil Engineering takes pride in listing the Sections that have gone over the top in the drive for funds for the UEC. The current Honor Roll carries 35 Sections, listed in the order of meeting their quotas. Newcomers to the list are the Duluth and Virginia Sections.

Kentucky (122)
Lehigh Valley (138)
Nashville (102)
Cincinnati (141)
Columbia (133)
Philadelphia (152)
Hawaii (128)
Rochester (123)
Ithaca (142)
Southern Idaho (200)
Indiana (139)
Delaware (109)
Kansas City (115)
Central Pennsylvania (109)
Arizona (110)
West Virginia (140)
Central Ohio (107)
Tri-City (114)
Puerto Rico (116)
Wisconsin (105)
Georgia (109)
Maryland (107)
Tennessee Valley (107)
Metropolitan (114)
Connecticut (107)
Maine (102)
Rhode Island (100)
Alaska (105)
Central Illinois (107)
Syracuse (103)
Illinois (102)
Nebraska (105)
Iowa (105)
Duluth (100)
Virginia (100)

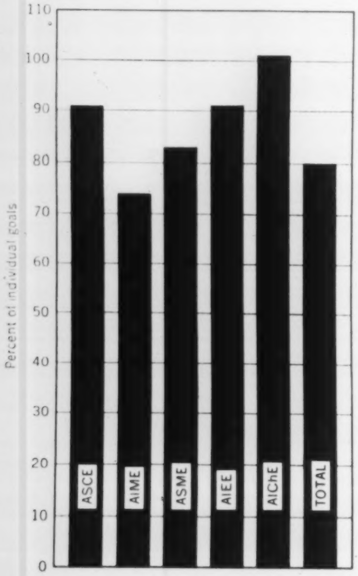
Total Amounts Necessary to Meet Local Section Quotas

San Francisco	$93
Panama	305
Tacoma	376
Spokane	438
Mexico	675
Mid-Missouri	923
South Dakota	944
New Hampshire	977
Montana	988
Buffalo	1,010
Wyoming	1,065
Dayton	1,074
Akron	1,112
Oklahoma	1,131
Intermountain	1,170
Toledo	1,197
Mass.	1,393
Brazil	1,795
North Carolina	1,899
Kansas	1,920
New Mexico	1,945
Cleveland	1,960
Seattle	$1,964
St. Louis	2,078
Miami	2,095
Mohawk-Hudson	2,097
Rep. Colombia	2,170
Venezuelan	2,213
South Carolina	307
San Diego	2,784
Sacramento	3,113
Pittsburgh	3,504
Northwestern	4,218
Mid-South	4,259
Texas	4,351
Alabama	4,572
Oregon	5,159
Louisiana	6,620
Florida	7,601
Colorado	8,325
Michigan	9,620
Nat'l Capital	11,936
Los Angeles	18,046

LET'S GET THE JOB DONE—BY JUNE!

- **Have you contributed?**
- **If you haven't,** return the filled-in pledge card now.
- **If you don't have a card,** phone your local committee or the Section secretary or write ASCE—today.
- **If you have pledged,** check with your local committee and help contact those who haven't contributed.

  The mail request to all members was not productive. To put your Section and your District over the top takes personal contact.
- **Help with this clean-up to complete the campaign by June.**



As of March 11, ASCE member giving for the UEC is 91 percent completed.

Three of five winners of ASCE 1959 Research Prizes received their prizes at the Awards Luncheon during the recent New Orleans Convention. Shown here, left to right, are Prize Winners George S. Vincent, Daniel Frederick, and Charles L. Bretschneider, with Thomas J. Fratar, Board of Direction Contact Member to the ASCE Research Committee.

ASCE Research Prizes Awarded During Convention

Presentation of the ASCE Research Prizes for 1959 was a feature of the Awards Luncheon held during the Annual Convention. Present to receive their awards from President Marston were Charles L. Bretschneider, Daniel Frederick, and George S. Vincent. The two other winners are Norman Brooks and Arthur Casagrande.

Charles L. Bretschneider, since 1956 a hydraulic engineer in the Research Division of the Beach Erosion Board, Washington, D. C., was formerly research engineer for the Texas A & M Research Foundation and the University of California Institute of Engineering Research. Graduating from Hillsdale College (Hillsdale, Mich.) in 1947, he has an M.S. in civil engineering from the University of California and a Ph.D. in physical oceanography from Texas A & M College. Dr. Bretschneider was cited "in recognition of an outstanding contribution to the knowledge of coastal engineering."

Norman H. Brooks, who has been on the teaching staff at the California Institute of Technology since 1950, was cited by the Society "in recognition of an outstanding contribution to the knowledge of the mechanics of alluvial streams." Graduating with a bachelor's degree in mathematics from Harvard College in 1949, Dr. Brooks received a master's degree in civil engineering from Harvard in 1950, and won a Ph. D. in civil engineering and physics at the California Institute of Technology in 1954. His special interests include sedimentation, transport in streams, and hydraulics in alluvial channels.

Arthur Casagrande, professor of civil engineering at Harvard University, was cited "in recognition of an outstanding contribution to basic research in soil mechanics and foundation engineering." A native of old Austria, in an area now in Yugoslavia, Professor Casagrande graduated as a civil engineer from the Technical University, Vienna, which also conferred on him the degree of doctor of technical sciences. He has several honorary doctorates.

Daniel Frederick, has been on the teaching and research staffs at Virginia Polytechnic Institute since 1946, and has been professor of engineering mechanics since 1955. He is a graduate of VPI, and also attended Ohio State University and the University of Michigan. He was cited "in recognition of an outstanding contribution to the analysis of thick plates and skewed plates on elastic foundations."

George S. Vincent has spent most of his career with the U.S. Bureau of Public Roads, and is now chief of the Bridge Research Branch in the Division of Physical Research. He was cited "in recognition of an outstanding contribution to research on the aerodynamic characteristics and behavior of suspension bridges." He is a graduate of Oregon State College.

The ASCE Research Prizes were established in 1946 to stimulate research in civil engineering. Each award consists of $100 and a suitable certificate.

Engineering Mechanics Division Conference

A conference on structural mechanics will be held at Purdue University, on Thursday and Friday, May 5 and 6, under sponsorship of the Society's Engineering Mechanics Division. There will be three half-day technical sessions. The first, on Thursday afternoon, will deal with "Members and Frames." Four papers will be presented at this session. The Friday morning program, of four papers also, will center about the theme of "Plasticity." The Friday afternoon program will feature three papers in the field of "Dynamics."

On Thursday evening there will be a joint banquet with the Indiana Section and the ASCE Student Chapters in the area, to be held at the Purdue Memorial Union Building. The participating Chapters, in addition to Purdue, will be the University of Notre Dame, Rose Polytechnic Institute, and Valparaiso University. The featured after-dinner speaker will be Mario G. Salvadori, professor of civil engineering at Columbia University and widely known as a fascinating speaker. His subject will be "Mankind Faces a Technological Culture."

Theodore Von Karman Medal Established

The Theodore Von Karman Medal has been established and endowed by the Society's Engineering Mechanics Division, with contributions presented by the friends and admirers of Theodore Von Karman, Hon. M. ASCE. According to the rules of award established by the Board of Direction at its New Orleans meeting, the medal will be awarded "to an individual in recognition of distinguished achievement in engineering mechanics, applicable to any branch of civil engineering." Age, nationality, and Society membership shall not be considered in making the award.

Normally an award will be made every year. However, it may be omitted at the discretion of the Award Committee and when operating income is insufficient to meet necessary expenses. If funds are available, more than one award may be made in a year, normally for joint accomplishment.

The Award Committee is to consist of the members of the Advisory Board of the Engineering Mechanics Division, who will recommend nominees for formal action by the Board of Direction.

Tacoma Host City to Pacific Northwest Conference

Arrangements have now been completed for the Twelfth Annual Conference of the Pacific Northwest Council, to be held in Tacoma, Wash., April 22 and 23. On hand to welcome members and their wives at the opening luncheon on Friday, April 22, will be the Hon. Albert D. Rosellini, governor of Washington; the Hon. Ben Hanson, mayor of Tacoma; and Harold A. Hagestad, president of the host (Tacoma) Section.

Technical sessions, under the chairmanship of Dr. Arthur Anderson, will feature three top-flight papers. They are "Frontiers of Civil Engineering in Radar Photogrammetry," by Prof. C. L. Miller, of Massachusetts Institute of Technology; "Limit Design in Concrete," by Allen H. Mattock, senior development engineer for the Portland Cement Association, Chicago, Ill.; and a panel discussion on "Some Aspects of Riveted Plate Girder Research," headed by Prof. Desi Vasarhelyi, of the University of Washington.

The stag party program, Friday night, will present ASCE President Frank A. Marston, whose talk will center on highlights in ASCE progress, and William A. Bugge, director of highways for the State of Washington, whose topic will be "Frontiers in Highway Engineering and Progress."

Saturday morning buses will leave the headquarters hotel, the Winthrop, for the Hood Canal Floating Bridge, now under construction. An article in the December 1959 issue gives details on this interesting project. After inspecting the bridge, the group will go by bus to the Bremerton Navy Yard for a visit to the largest dry dock in the world, which is under construction there.

New officers will be installed Saturday night. The theme of the Saturday night program is South Sea Islands, and there will be a Hawaiian Laua and Samoan Sword Dances. For this event the engineers will wear flowered sports shirts and their ladies flowered Hawaiian dresses.

In conjunction with the conference, the ASCE Executive Committee and the Pacific Northwestern Conference of Local Sections will meet in Tacoma.

George Washington Survey Office Dedicated

ASCE Director Daniel B. Ventres attended dedication of the George Washington Survey Office on February 20. Ceremonies were sponsored by the George Washington Boyhood Home Restoration, Inc., a voluntary group pledged to restore Ferry Farm, where Washington lived between 1738 and 1752 and where he learned to survey. In front row Captain Ventres discusses surveying instrument similar to the one Washington used with Michael F. Doyle who is holding the instrument. In back row are directors of group: Alfred W. Garnett, William H. Kilian (president of group), C. B. McDaniel (in doorway), Nile Straughan (no hat), Walter N. Chinn, Jr., Edward H. Cann (no hat), Lawrence G. Hoes, Oscar H. Darter (no hat), and Kenneth S. Coe (no hat).

Arthur W. Crouch (left) received the R. Paul Farrell Award of Merit given by the Nashville Chapter of the Tennessee Society of Professional Engineers at the All Engineers' Dinner held during Engineers' Week. The award, which has been given only twice in the past eleven years, goes for "contributions to the community and the engineering profession." In this photo Mr. Crouch receives the congratulations of John R. Hollinshead, award chairman for the Nashville Chapter, TSPE. Both Mr. Crouch and Mr. Hollinshead are members of the Nashville Section of ASCE.

ASCE Sections Take Part in Engineers' Week

Engineers' Week, held late in February under the auspices of the National Society of Professional Engineers, was marked by many dinners and special programs. All over the country ASCE Sections joined local groups of the other Founder Societies in joint tribute to the profession.

At a luncheon meeting of the Engineering Societies of New England and the Massachusetts Society of Professional Engineers, which marked Engineers' Week in Boston, Asa S. Knowles, president of Northeastern University, addressed the joint group on the "Challenge to Engineers for the 1960's." The substance of Dr. Knowles' talk was that, "Scientists and engineers must become an influence in politics, and they must make themselves understood by politicians."

According to Dr. Knowles, the challenges which engineers must face and resolve if our nation is to take full advantage of its technological potential are: (1) Encouragement of able American youth to become engineers, scientists, and technicians; (2) encouragement of continuing education for engineers and scientists; (3) encouragement of international centers for advanced study; (4) promotion of international standards; and (5) encouragement of research and development.

More than 600 engineers attended the luncheon meeting.

Central Pennsylvania Section of ASCE was host during Engineers' Week to the Harrisburg Chapter of the Pennsylvania Society of Professional Engineers and the Engineers Society of Western Pennsylvania. Here, in usual order, are Robert H. Klucher, president of Central Pennsylvania Section; Louis Shope, president of Harrisburg Chapter of Pennsylvania Society of Professional Engineers; P. E. Tillison, former president of ESWP; and Park H. Martin, Honorary Member of ASCE and Secretary of Highways in Pennsylvania. In the featured address, Mr. Martin reviewed Pennsylvania's highway program. Mr. Klucher, district engineer of the Pennsylvania Department of Highways at Harrisburg, is being transferred to Pittsburgh. He will be succeeded as Section president by John R. Deitz.

Washington Award Goes To Electrical Engineer

Herbert Payne Sedwick, a member of the AIEE and leader in the electric and gas utility industry, is winner of the Washington Award for 1960. He is cited "for leadership and achievement in electric and gas utilities, for true service in educational and humanitarian fields for developing young engineers." Presentation of the award to Mr. Sedwick took place at a dinner sponsored by the Western Society of Engineers in Chicago late in February.

In his forty-five years of service to the utility industry, Mr. Sedwick has been responsible for many innovations and improvements. At the time of his retirement in 1958 he was executive vice president of the Commonwealth Edison Company and president of its Public Service Division. As member and president of the Western Society of Engineers, he has been instrumental in organizing the society's Young Engineers Forum.

The Washington Award is administered jointly by the four Founder Societies and the Western Society of Engineers. It was established in 1916 by the late John W. Alvord, Honorary Member of ASCE. It is given annually "for accomplishments which preeminently promote the happiness, comfort, and well being of humanity."

JOB REPORT: *NELSON Stud Shear Connectors In Composite Bridge Construction*

NELSON Stud Shear Connectors *provide greater design flexibility . . . faster installation . . . more efficient concrete compaction . . . equal shear in all directions . . . permanent hold-down and less beam distortion than obtainable through the use of other connectors.*

COMPOSITE CONSTRUCTION*

specified for new Long Island expressway

Structural and economic advantages, as typified in this new Roslyn, L. I., expressway, prove the increasing acceptance of composite construction...

*A steel and concrete composite beam is made up of three essential elements: A steel beam, a reinforced concrete slab, and shear connectors. Horizontal shear is transferred to the beam through the shear devices which join the slab to the beam in such a way as to cause the concrete and steel elements to act as a unit.

LONG ISLAND EXPRESSWAY (Guinea Woods Road, Roslyn, L. I.) **Designers:** New York State Dept. of Public Works. **Consulting Engineers:** Andrews & Clark. **General Contractors:** Tuckahoe Davis Construction Co. **Steel Fabricator:** Central Iron Works. **Shear Connector Applicator-Contractor:** W. R. Johnson, Jr., Associates, Inc.

A composite structure is stronger and stiffer than a non-composite structure consisting of the same beams and slab. Composite design provides a substantial decrease in beam depth or economical use of rolled sections for longer spans. And with this method of design your structures possess overload capacity and toughness substantially in excess of the overload capacity and toughness of non-composite structures. This, plus the ease and speed of construction, the clean, esthetic appearance and simplicity of design warrants the investigation of composite construction for your next job. Nelson Stud Welding Division, Gregory Industries, Inc., Dept. 10, Lorain, Ohio.

NELSON® Stud Welding *a cost-saving product of*

GREGORY INDUSTRIES, INC.
LORAIN, OHIO

E. L. Chandler First Winner of Professional Award

The Professional Achievement Award was officially instituted by the Board of Direction during its New Orleans Convention meetings. On unanimous recommendation of the Conditions of Practice Executive Committee, the Board also voted to desigate E. Lawrence Chandler the first recipient of the Professional Achievement Award. Mr. Chandler is retiring this spring from his post as Assistant Secretary of ASCE after many years of service to the Society.

The new award was established in 1959 with funds contributed by Edmund Friedman, former Director and Vice President of the Society. Its purpose is "to recognize the importance of professional attainment in the advancement of the science and profession of engineering" as defined by the Constitution of the Society.

According to rules of award established by the Board, the award is to be made annually to a member of the Society, who is judged to have contributed substantially to the status of the engineering profession by:

E. LAWRENCE CHANDLER

1. Exemplary professional conduct in a specific outstanding instance.
2. An established reputation for professional service.
3. Objective and lasting achievement in improving the conditions under which professional engineers serve in public and private practice.
4. Significant contribution toward improvement of employment conditions among civil engineers.
5. Significant contribution toward improving the professional aspects of civil engineering education.
6. Professional guidance of qualified young men who would seek civil engineering as a career; and professional development of young civil engineers in the formative stages of their careers.
7. Other evidence of merit which, in the judgment of the Award Committee, shall have advanced the Society's professional objectives.

The award is to be made once each year when, in the judgment of the Award Committee, a suitable candidate is available. Only one recipient will be named in any year, and no recipient may receive the award more than once. The Award Committee is to be the Executive Committee of the Committee on Conditions of Practice. Its recommendation, accompanied by an appropriate citation, is to be reported to the Board of Direction annually, at the Summer Convention.

SOCIETY AWARDS AND FELLOWSHIPS AVAILABLE

DANIEL W. MEAD PRIZES:	*1960 contest closes May 1, 1960. See 1960 Official Register, page 149, and July 1959 issue of CIVIL ENGINEERING, page 66.*
FREEMAN FELLOWSHIP:	*1960 contest closes April 15, 1960. See Official Register, page 154.*
ERNEST E. HOWARD AWARD:	*Closing date Feb. 1, 1961. See Official Register, page 148.*
J. WALDO SMITH HYDRAULIC FELLOWSHIP:	*1961-62 contest closes April 1, 1961. See Official Register, page 156.*
RESEARCH FELLOWSHIP:	*1961 contest closes Jan. 1, 1961. See Official Register, page 156.*

Pacific Southwest Student Conference

For the first time, this year's Pacific Southwest Student Chapter Conference will be held as a separate meeting instead of as a part of the annual Pacific Southwest Conference. Host to the two-day meeting will be the University of Nevada Student Chapter at Reno, Nev. The dates will be Saturday and Sunday, May 7 and 8. The program will get started early Saturday, with registration set for 8:30 to 9:15 a.m. The morning will be devoted to business, and the afternoon to the annual Student Paper Contest. Announcement of the winners will be made at the evening banquet, set for 7:00 p.m. Clair Hill, president of the Sacramento Section and a consulting engineer of Redding, Calif., will be the featured banquet speaker.

On Sunday, May 8, there will be field trips to Squaw Valley, site of the Winter Olympics, and to Virginia City, famous and colorful old mining town.

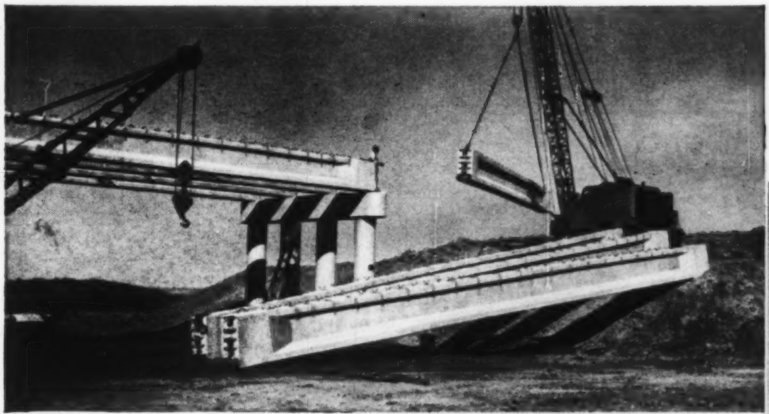
Engineering Curricula Conference Set for July

The scope and content of civil engineering curricula of the future will be the business of an open conference to be held at the University of Michigan, July 6-8, 1960. In anticipation of the summer conference, thirty engineers and educators have already held two three-day planning conferences at Cooper Union's Green Engineering Camp in northern New Jersey.

Every university having an accredited civil engineering department will be invited to send a delegate to the Michigan meeting which will consider requirements and trends of undergraduate civil engineering education. Results and recommendations should have far-reaching effects on civil engineering teaching in the United States.

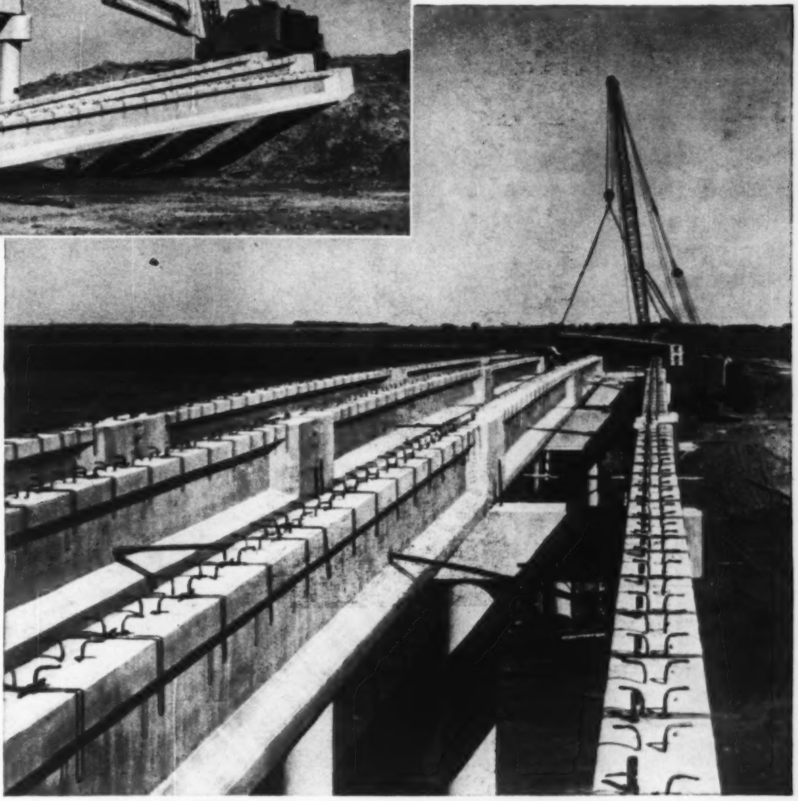
The conference, co-sponsored by the American Society of Civil Engineers, the American Society for Engineering Education, and Cooper Union, was made possible by a grant of over $40,000 from the National Science Foundation.

Further information and registration material may be obtained from Dr. Felix A. Wallace, Cooper Union, New York 3, N. Y.



End span beams are 42′ 7″ long. All beams have a depth of 45″.

Beam placement nears completion. Center span beams are 67′ 8″ long.



Owner:
North Dakota Highway Department

Contractor:
Otto J. Eickhof & Sons, Inc., Crookston, Minn.

Manufacturer of Prestressed Beams:
Concrete Sectional Culvert Co., Fargo, N.D.

Prestressed Concrete
for NORTH DAKOTA BRIDGE

As the Interstate Highway program moves forward, an increasing percentage of its structures is being designed for prestressed concrete beams. The reasons: low first cost, minimum maintenance, fast, easy erection, and attractive appearance.

A recent example is this bridge over new Interstate Route 94 near Fargo, North Dakota. It is constructed of 16 prestressed I beams, eight of which are 67′ 8″ long; the other eight are 42′ 7″ long.

In the manufacture of these beams, Concrete Sectional Culvert Company used Lehigh Early Strength Cement for maximum production efficiency. Early removal of units and quick re-use of casting beds permitted a most economical casting cycle.

This is typical of the advantages of Lehigh Early Strength Cement in modern concrete construction. Lehigh Portland Cement Company, Allentown, Pa.

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The Younger Viewpoint

Committee on Younger Member Publications

Milton Alpern, Chairman; 3536 Northview Ave., Wantagh, L. I., N. Y.

Zone I	Zone II	Zone III	Zone IV
Donald Kowtko 289 Foxhill Road Denville, N. J.	**Albert C. Nelson** 250 N.E. 51st Street Miami, Fla.	**Walter D. Linzing** 4751 No. Paulina Chicago 40, Ill.	**Judd Hull** 3178 Almeria San Pedro, Calif.

Walter D. Linzing, Zone III representative, is this month's editor.

Where ASCE Fails—One Associate Member's Opinion

Originally printed in the Illinois Section Newsletter and reprinted in the Wisconsin Section Newsletter, the following letter is hereby published for national discussion, rebuttal, and introspection.

Gordon J. Stepanek was asked to put in writing some of the reasons why he did not take a more active part in ASCE. In response to this request, Mr. Stepanek submitted the following answer:

"During the idealistic college and early post-college years, affiliation and activity in the ASCE was a symbol of status and a way of asserting my willingness to serve society. I was proud to belong.

"In those days my goals were altruistic. Gradually, as so often seems to be the way of things as personal contacts expand beyond those of similar training and aspiration, my interests changed more and more to the mundane.

"I found that practically all my friends in other work were not content to merely serve, but wanted specific appreciation for their effort—usually money and position. The healthy, competitive struggle of a capitalistic society became real.

"Then I realized that many of the older ASCE members had known the importance of this competitive economic struggle, but were assuming the role of 'financial martyrs.'

"I became disillusioned when the old timers bragged about their low starting wages as compared with the "excessive" salaries of today's graduates. I became discouraged when they talked about long hours of difficult painstaking work for small appreciation as the proper birthright of engineers—before, now and forever! It became my belief that toil without proper appreciation in return may be suitable for stupid animal, but is degrading for an educated man. It became my opinion that ASCE members fear admitting to themselves that in our complex, expanding world the engineer must *sell* the high value of his *important* work in a competitive market—competing against other segments not against fellow professionals. Altruism will not do it.

"The stated objectives of ASCE are the advancement of the science and profession of engineering. ASCE efforts toward promoting the advancement of the science of engineering can only be commended. If this were the only objective, the ASCE would, in my opinion, be a great success. Concerning the advancement of the profession, in my opinion, the ASCE loses out to other engineering groups in a competitive field.

"A moral man wants to 'give' to his profession, but the ASCE has not earned an exclusive franchise to receive."

One of the first reactions to the letter came from one of the older members of the Illinois Section, a member of the local board of directors who felt that the analogy to "a stupid animal" left something to be desired. Other comments are welcome, and a selection from them will be presented in this column.

ASCE Interested in Younger Members

The Committee on Younger Members, under the chairmanship of John Heinzerling, met in Chicago in January to discuss ways of helping the younger member in ASCE. Also present, in addition to the committee members, were Stuart Kirkpatrick and Otis Gouty, Assistants to the Secretary of the Society. Among many things discussed at the weekend meeting, a three-point program emerged as the focal point of committee action. Younger members of the ASCE should be interested to know that the committee is actively implementing the following program on their behalf:

1. Sending letters to employers of engineers asking them to encourage and permit younger engineers to participate in ASCE activities and meetings.
2. Working for ways to make "The Younger Viewpoint" of greater service to the younger members of ASCE.
3. Distributing ECPD (Engineers' Council for Professional Development) kits to all new members entering ASCE.

The main objective of the Committee on Younger Members was stated to be the professional development of the engineer in our society.

Suggestions

To create greater interest in and more contributions for "The Younger Viewpoint," the Illinois Section board of direction has established a Younger Viewpoint Committee. Bill Walker and Sven Johnson have been appointed to the committee and already have run several articles in a "Younger Viewpoint" column in the Section newsletter.

The Wisconsin Section has established a Younger Member Activities Committee. Among its responsibilities is to integrate younger members in Local Section affairs and to "report and recommend to the Board on matters of interest and concern to younger members." Chairman of the committee is Eugene Murawski, assisted by Duane Hinz, cochairman.

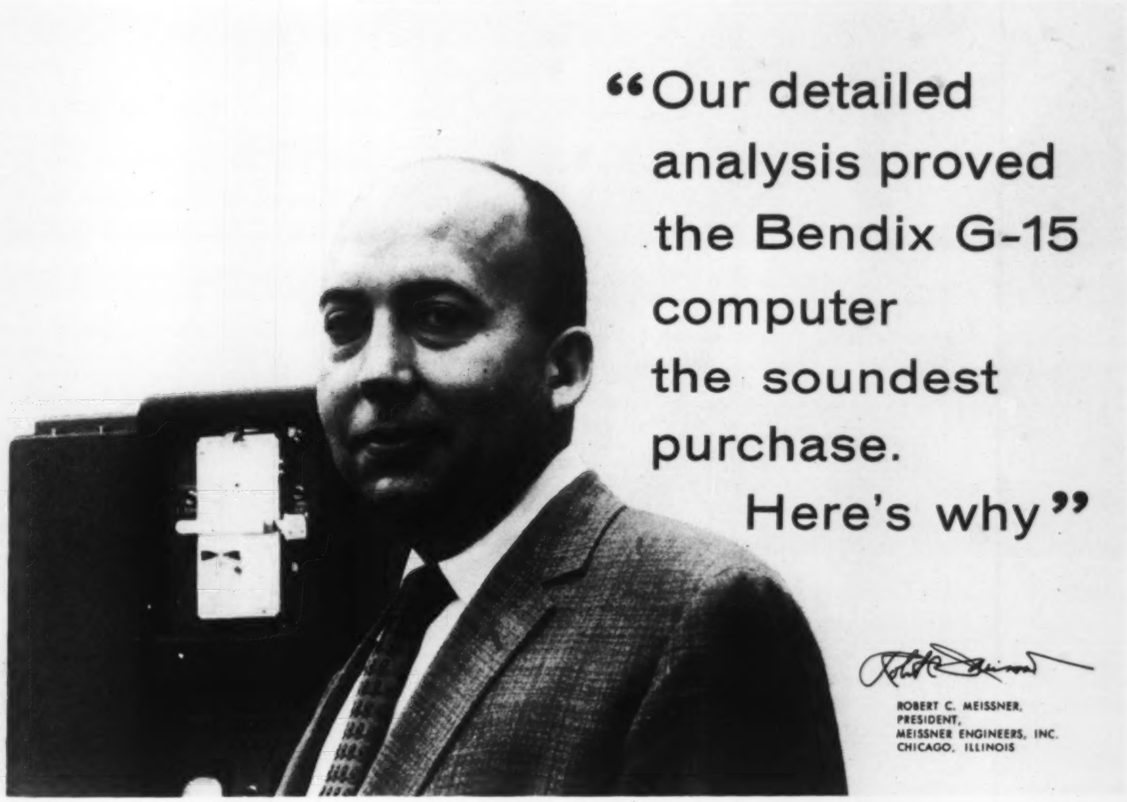
Other Sections interested in their younger members are encouraged to adopt similar programs. If Associate Members will take it upon themselves to develop such action, it is reasonable to assume that their local boards will be receptive to their ideas.

The Stock Market

One of the most important things to the young man is his investment program. As he provides for immediate needs, his family, and is adequately insured, he looks for investment opportunities. The sooner he is able to start an investment program, small though it may be, the greater are his chances of capital growth in our American system of free enterprise. A steadily rising income from prudent investments can, over the years, provide substantial additional yearly income and can add greatly to the base of a retirement fund or plan. One vehicle of investment, of course, is in the stock and bond markets. It is interesting to note that both the Illinois and Wisconsin Sections presented programs in the month of March on the stock market and its future.

ASCE Membership as of March 9, 1960

Fellows	10,933
Members	15,880
Associate Members	18,016
Affiliates	94
Honorary Members	47
Total	44,970
(March 9, 1959	42,350)



“Our detailed analysis proved the Bendix G-15 computer the soundest purchase. Here's why”

ROBERT C. MEISSNER,
PRESIDENT,
MEISSNER ENGINEERS, INC.
CHICAGO, ILLINOIS

Over 200 firms are enthusiastic users of the Bendix G-15 computer. Many, like the consulting engineering firm of Meissner Engineers, Inc., are involved in the heavy construction industry. Before purchasing, Meissner meticulously studied all medium-scale computers. “Only the G-15 gives us the *speed, expandability, price*, and *ease of operation* we require,” says Mr. Meissner.

Mr. Meissner continues:

Speed: “The G-15 is faster than other computers in its price range, and for many problems gives us the answers we need in less than 1% of the time required by manual methods.”

Expandability: “The variety of accessories for the G-15 is a very important feature. As we developed and expanded our applications, we added magnetic tape units, punched card equipment, and other special accessories.”

Ease of Operation: “Our engineers find the G-15 Intercom 1000 programming system easy to master. It permits them to write versatile programs which can handle practically all of our problems.”

The G-15 is the leader in its field for many other reasons as well: A price much lower than any other medium-scale computer, a built-in, magazine-loaded photoelectric paper tape reader, and tape punch as standard equipment, an active user's group that shares hundreds of proven programs, and fast, nationwide service.

G-15's are being applied successfully in a great many fields — business data processing, scientific and engineering calculations. Write us your specific problems.

Bendix Computer

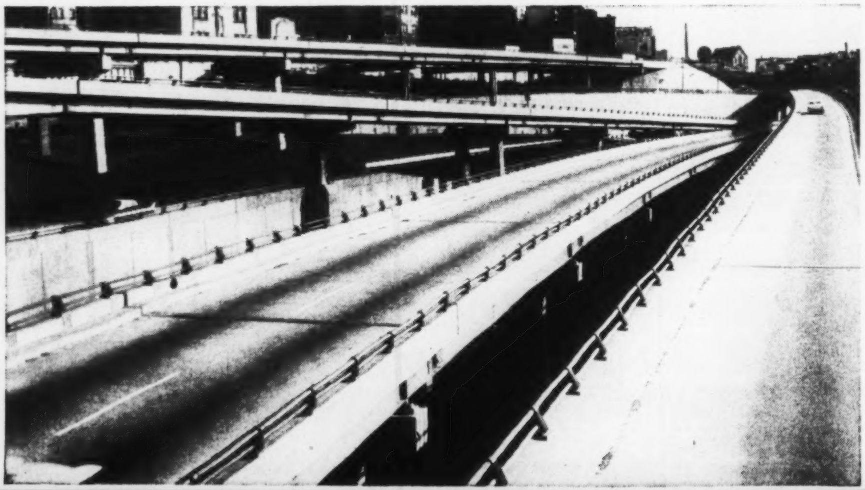
DIVISION OF BENDIX AVIATION CORPORATION

DEPT. P-17

LOS ANGELES 45, CALIFORNIA

Steel members provide better clearance, faster construction on Brady Street Interchange.

Brady Street Interchange, Pittsburgh, Pa., part of the $100 million highway job, carries the Penn Lincoln Parkway and U. S. Routes 30 and 22.



Keep our roads on the GO

Steel is used for 80% of the bridges

designed by Richardson, Gordon and Associates, Pittsburgh, Pennsylvania

By using steel for the nine structures comprising the complex Brady Street Interchange in downtown Pittsburgh, Richardson, Gordon and Associates avoided extra engineering costs, kept traffic tie-ups to a minimum, and held grades within practical limits. The hilly terrain in Pittsburgh imposes severe restrictions on the designer. Steel saved valuable inches of clearance, and every inch saved meant improved interchange layout.

The firm of Richardson, Gordon and Associates has had a major role in engineering such impressive projects as the $50 million section of the Indiana Toll Road, involving the Gary-West Interchange near the Chicago city line; relocation studies of the $38 million Interstate project from the California line to Reno, Nevada, and design of a part of it; and $100 million worth of highway relocation and new expressway construction in the Pittsburgh area.

Mr. Richardson says that they enjoy designing with steel . . . it's a versatile working material, and they know exactly what its performance will be. More than 80% of their bridge designs employ steel throughout. Steel can be transported rapidly and in great quantities when long distances are involved. Since all projects are handled on a time schedule, this feature alone could mean the difference between profit and loss on a given job. Then, too, steel is not difficult to handle, when being transported or placed in a structure.

Increased facilities. Because of the vigorous, ever-expanding demand for steel structures, United States Steel has greatly expanded its facilities for the manufacture of structural shapes and plates. You can confidently design in steel—the material that offers most—knowing that steel will meet your needs and be available. *USS is a registered trademark*

Mr. George S. Richardson, Senior Partner of Richardson, Gordon and Associates and Mr. James H. Morehouse, Partner, examine scale model of Brady Street Interchange, Pittsburgh. In the background is photo of the Delaware River Turnpike Bridge which won Honorable Mention—Class I in the 1956 Annual Bridge Competition of the Institute of Steel Construction.

USS

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company

United States Steel

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

The newly formed Structures Division of the **Georgia Section** held its first meeting on February 19. There were 22 present for an excellent talk by Jim Fincher on "The Use of Computers on Design."

It appears feasible to reach the Moon and even Mars within the next quarter century, if funds are available for continued research. This was the thesis of the principal talk at the **Maryland Section's** February meeting. Defining space "as one step beyond imagination," Lester K. Fero, project engineer for the Glenn L. Martin Company, said that the theories and present-day concepts of space, the galaxies, and space travel are limited only by the boldness of the imagination of the scientist delving into the problem.

The investigation and construction techniques of underground storage caverns within rock formations were discussed by Daniel Geary, project engineer with Fenix & Scisson, Inc., at the **Philadephia Section's** February 9 meeting. Since these caverns are usually constructed at depths of 300 to 400 ft below surface, the designer must be constantly alert to the dangers of faults, fractures and unfavorable geological formations. Several key reasons why the method is suitable for certain types of liquified petroleum gases in selected regions of the country are the relatively low cost, land area availability, advantages of constant underground temperatures, and higher safety factors relative to fire hazards (as from lightning), and tornado damage. Of the 28 underground caverns constructed in the United States, Mr. Geary's Company has completed 24.

Highlight of the February 16 meeting of the **San Francisco Section** was the presentation of the Daniel W. Mead Prize to L. G. McLaren by ASCE Vice President Lawrence Elsener. Mr. McLaren was 1959 student winner of the Mead Prize for his paper on the "Responsibilities of the Engineer to his Employer." Before adjoining for the evening, Kenneth M. Hoover, chief engineer of the Bay Area Rapid Transit District, gave a talk on the problems confronting the transportation systems in the area and the proposed solution.

Guest speaker at the February 12 meeting of the **Spokane Section** was David C. Guilbert, manager of the Inland Automobile Association and secretary of the Spokane County Good Roads Association. His talk was on impending legislation at both state and national level involving improved highways and public roads.

The **Tacoma Section** recently named Walter A. Bugge, director of the Washington State Highway Department and vice president of the American Road Builders Association, "Engineer of the Year." The award is given by the Section to the engineer in the area who has been most outstanding in the engineering profession and public service.

Attending winter meeting of the North Carolina Section in Raleigh are (left to right) L. C. Cheek, city engineer of Charlotte; Prof. John W. Horn, secretary-treasurer of the North Carolina Section; Carl W. Mengel; Joseph N. Stribling; and T. P. Noe, Jr., president of the Section. During the program Mr. Cheek presented Life Membership Certificates to Carl W. Mengel, Joseph N. Stribbling and Clayton L. King (in absentia). Other new officers not shown here are C. R. McCullough and R. S. Rawlins.

ASCE CONVENTIONS

RENO CONVENTION

Reno, Nev.
June 20-24, 1960

ANNUAL CONVENTION

Boston, Mass.
Hotel Statler
October 10-14, 1960

PHOENIX CONVENTION

Phoenix, Ariz.
Hotel Westward Ho
April 10-14, 1961

DISTRICT CONFERENCES

DISTRICT 9 COUNCIL

Columbus, Ohio
April 29-30, 1960

Host

Central Ohio Section

PACIFIC NORTHWEST COUNCIL

Tacoma, Wash.
April 22-23, 1960

Host

Tacoma Section

TECHNICAL DIVISION MEETINGS

ENGINEERING MECHANICS DIVISION CONFERENCE

Lafayette, Ind.
Purdue University
May 5-6, 1960

Sponsored by

Engineering Mechanics Division

RESEARCH CONFERENCE ON SHEAR STRENGTH OF COHESIVE SOILS

Boulder, Colo.
University of Colorado
June 13-17, 1960

Sponsored by

Soil Mechanics and
Foundations Division

HYDRAULICS CONFERENCE

Seattle, Wash.
University of Washington
August 17-19, 1960

Sponsored by

Hydraulics Division

CONFERENCE ON ELECTRONIC COMPUTATION

Pittsburgh, Pa.
Hilton Hotel
September 8-9, 1960

Sponsored by

Structural Division

"Not a 'comeback' in 18 years" ...with Transite Sewer Pipe

says Anthony Garcia, President
Allerton Construction Co., New York

"In my eighteen years of installing Transite sewer mains and house laterals, I have never had a 'comeback' because of line failures. Most of the installations have been 100% under water. Therefore, tight joints that stay tight are absolutely essential! For these reasons Transite has always been my choice for sewer line service. I never worry about passing leakage or infiltration tests. I play it safe—with Transite."

You'll want to read how Johns-Manville Transite® Pipe has helped other contractors increase their profits and productivity . . . in the informative and interesting new, 8-page booklet, TR-206A. Send for it now! Address Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario.

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PRODUCTS

Detroit Councilman Eugene I. Van Antwerp (second from left) received his Life Membership Certificate at the March meeting of the Michigan Section. Taking part in the presentation are (in usual order) Stuart B. Maynard, Robert B. Harris, Creighton C. Lederer, Austin J. Miller, Franklin H. Chapin and Leonard L. Klein. Councilman Van Antwerp, who served as mayor of Detroit in 1948 and 1949, spoke appropriately on the engineer in public service.

Executive Secretary William H. Wisely (left) was featured speaker at the Kansas City Section's February meeting with a talk on the value of ASCE membership for the professional man. He is shown with Section President Jack Daily (center) and ASCE Director N. T. Veatch, who accompanied Mr. Wisely on part of his tour of Midwest Sections.

The Panama Section had as guest of honor and speaker at its February meeting Lt. General Emerson C. Itschner (second from left), Chief of Engineers of the U. S. Army. Listening to the talk on the world-wide activities of the Corps of Engineers are (left to right) Lt. Col. Robert D. Brown, Jr., engineering and construction director of the Panama Canal Company; Joseph M. Cooke, president of the Panama Section; and Gale A. O'Connell, secretary-treasurer.

AMERICAN
SO
RS

LOCAL SECTION MEETINGS

Akron—Regular monthly meeting at the Hotel Belden in Canton, Ohio, on Thursday, April 21.

Georgia—Regular monthly meeting at the Architects and Engineers Institute on May 6. The Student Chapter of Georgia Tech will have charge of the program.

Illinois—Weekly luncheon meetings at the Engineers' Club in Chicago every Friday, at 12 noon.

Intermountain — Regular monthly meetings on the fourth Friday of each month; evening meeting of the Southern Utah Branch at the Columbia Iron Mining Company Office Building in Cedar City on April 20, at 7:30 p.m.

Metropolitan—Regular monthly meeting sponsored by the Sanitary Engineering Seminar Group at the Engineering Societies Building on April 20, 7:00 p.m.

Oklahoma—Dinner meeting of the Tulsa Branch at Borden's Brook Plaza Cafeteria on May 2, at 6:30 p.m.

Philadelphia—Regular monthly meeting at the Engineers' Club on May 10.

Sacramento—Weekly meetings at the Elks Temple every Tuesday, at 12 noon.

San Francisco—Regular monthly meeting at the Engineers' Club on Tuesday, April 19.

Tennessee Valley—Spring meeting at The Manor in Asheville, N. C., May 13-14.

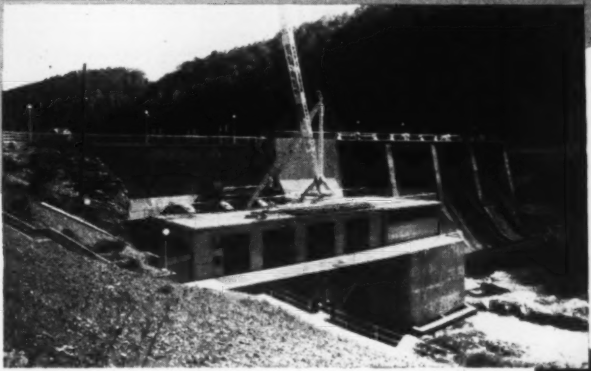
Texas—Spring meeting at the Scharbauer Hotel in Midland, Tex., April 21-23.

West Virginia—Joint meeting with the West Virginia University Student Chapter at Morgantown, W. Va., on April 29.

OCIETY OF
CIVIL
GINEER

Oregon Section President Walter J. Bushnell (left) relinquishes his duties to incoming President John T. Merrifield Other officers installed at recent annual dinner meeting were Holly A. Cornell, first vice-president; F. Stewart Brown, second vice-president; Robert L. Nordlander, treasurer; and Jack R. Gray, secretary.

TVA relies on Leffel Turbines

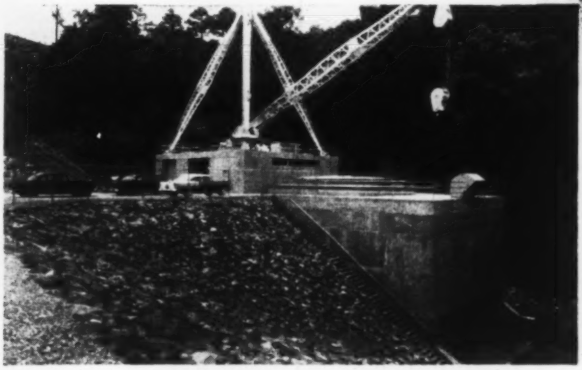


AT WILBUR DAM

In 1950, when the Tennessee Valley Authority decided to expand the capacity of the Wilbur Dam Power station, a Leffel vertical shaft propeller-type turbine was selected. This turbine is rated at 11,500 HP, operating at 180 RPM under a net head of 67 feet.

AT CHATUGE DAM

The Leffel turbine at Chatuge Dam, another TVA installation near Murphy, North Carolina was also installed in 1955. This turbine is rated at 13,000 HP at 180 RPM under a net head of 100 feet.



AT NOTTELY DAM

At TVA's Nottely Dam on the Nottely River near Murphy, North Carolina the generator is driven by a Leffel turbine installed in 1955. This turbine is rated at 21,000 HP, operating at 180 RPM under a 124 foot net head.

These three turbines have given entirely satisfactory service from their initial installation.

. . . AND SO CAN YOU

Whatever your waterpower requirements you'll find Leffel turbines tops for efficiency and reliability. And Leffel engineers, drawing on nearly a century of experience, are available without obligation to help you plan the installation which will give you maximum power from available water.

Whether you're planning the rehabilitation or expansion of existing facilities or the construction of a completely new installation, be sure to find out what Leffel can do to help you.

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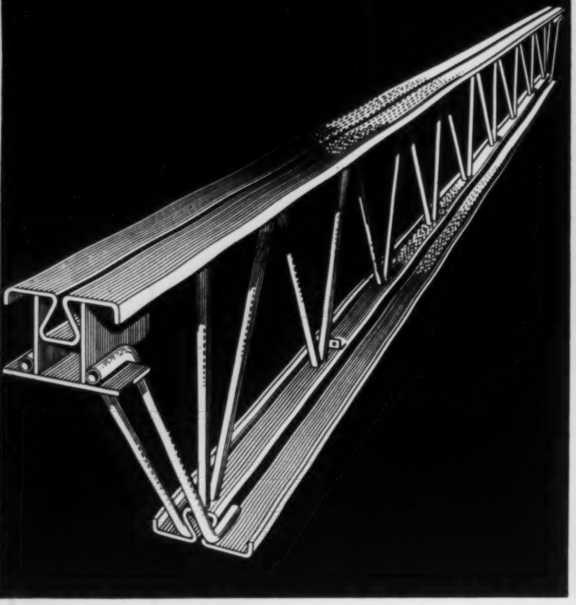
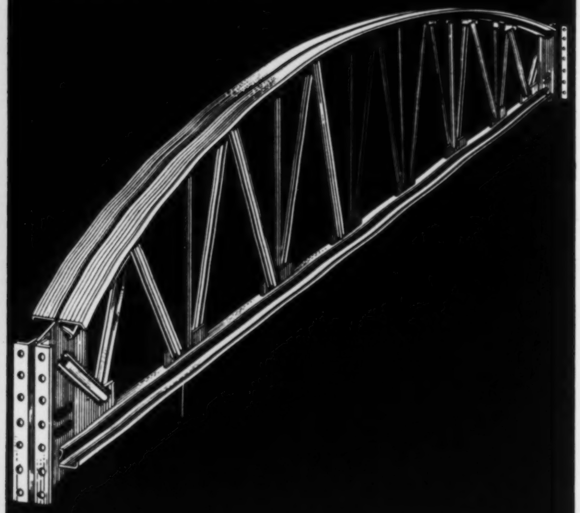
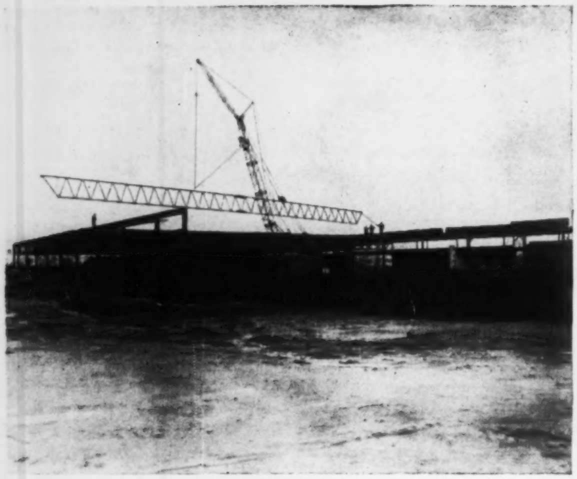


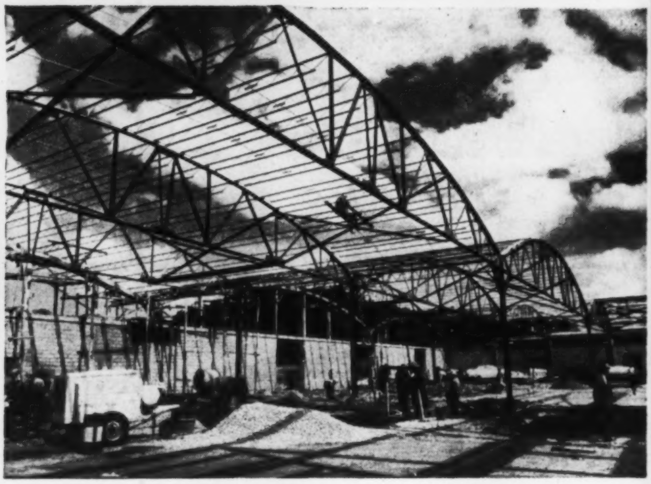
MACOMBER

BOWSTRING TRUSSES





Bowling Lanes—Wilmington, Delaware



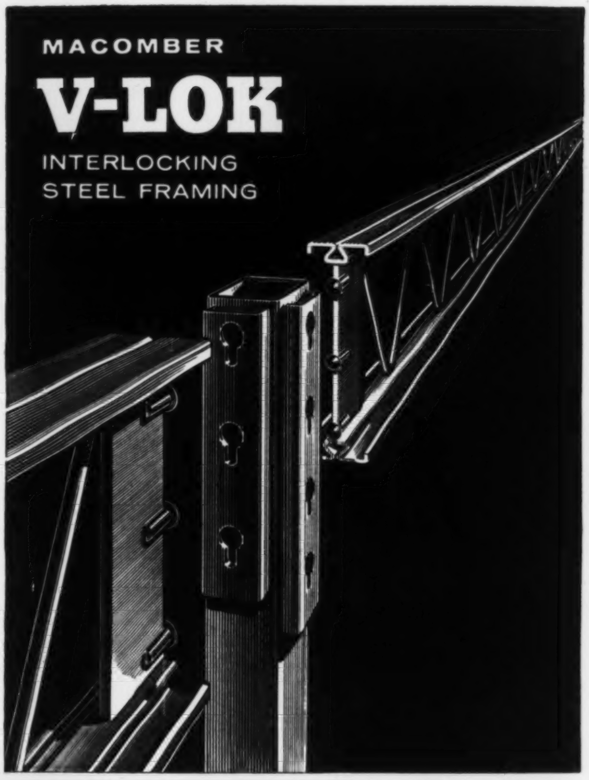
Sugar Warehouse—Guatemala City, Guatemala

SPANS TO 120 FEET—

Macomber high-strength ALLSPANS provide maximum lateral rigidity and reserve strength. This quality product covers the entire span range to 120 ft. without excessive weight — simplifies your design task.

STANDARDIZED TO SAVE DELIVERY TIME—

Macomber standardized all sizes of BOWSTRING TRUSSES to speed fabrication and delivery to your building site. Combined with ALLSPAN Purlins, Macomber BOWSTRING TRUSSES provide the most economical solution to wide-span framing problems.



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Your complete one-source supply for all structural steel requirements.

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Macomber V-LOK Interlocking Steel Framing reduces erection time from weeks to days, adapts readily to any architectural layout, collateral materials and mechanical installations.

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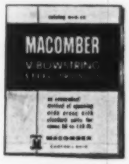

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The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

Notekeeper: W. & L. E. Gurley, America's Oldest Engineering Instrument Maker

Optical Plummet solves problem on Niagara Power Project

"Sometimes a seemingly little thing can make a big job easy," says Frank Dickey, Project Engineer on the Niagara Power Project for Channel Constructors—a joint venture of Peter Kiewit Sons' Co., Morrison-Knudsen Co., Perini Corp., and Walsh Construction Co.

"We had an unusual problem here on excavations for the 500-foot-wide channel which will handle the water for the new Niagara hydroelectric plant. The conduits will pick up water from the Niagara River a couple of miles above the Falls and carry it underground through the city to an open channel, reservoir and 2,190,000-kilowatt power plant located several miles down the river.

"The channel had to be cut from dolomite. We decided to line drill the full 105-foot depth at one time, using 6-inch diameter holes on 5-foot centers. It was our intent to line drill the entire job, some 1600 holes, before any of the excavation was finished to grade. This made it necessary to devise a method of checking the holes for plumb from the surface so as to be sure that they did not deviate enough to get outside the tolerance allowed by the specifications.

"We thought of several ways to do this but none very practical, until one of the men mentioned having used a Gurley Optical Plummet Transit on another kind of job up in Canada. We decided to try the 'bobless transit' here.

Frank Dickey (r.) checks Gurley Optical Plummet Transit on Niagara Power Project job.

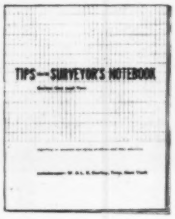
"We set up over the opening; then leveled the instrument with the North plate bubble over two opposing leveling screws. Then we sighted in the Optical Plummet and started moving the other two opposing leveling screws until we were able to pick up the light—by means of the 'OP'—from a dime store flashlight which had been lowered into the hole by a string.

"While moving the two opposite screws, we constantly checked the North plate vial to make sure that it remained level throughout the movement. After we picked up the light from down the hole, we moved the telescope until its bubble was in the center. When this was established, we read the vertical circle—this giving us the angle at which the hole had been drilled.

"This proved to be accurate and a fast system for checking the holes and undoubtedly gave us a better job than we could have otherwise obtained.

"This use of the 'OP' is a special case," Mr. Dickey added. "But I'll bet there will be many other jobs that the 'OP' can lick. For years I cussed the plumb bob, especially when the wind was blowing... always wished someone would do something about it."

You, too, can do something about the plumb bob problem. Gurley *built-in* optical plummets eliminate outmoded bobs... save set-up time... improve accuracy. *Bulletin OP-100 gives complete details on two models available.*



TIPS—SURVEYOR'S NOTEBOOK

***"Tips from The Surveyor's Notebook"**: We have collected the most helpful, most discussed pages from Series One and Two of "The Surveyor's Notebook" in one 20-page book. These valuable field suggestions will help you use your own instruments with greater success. Write for your free copy.*

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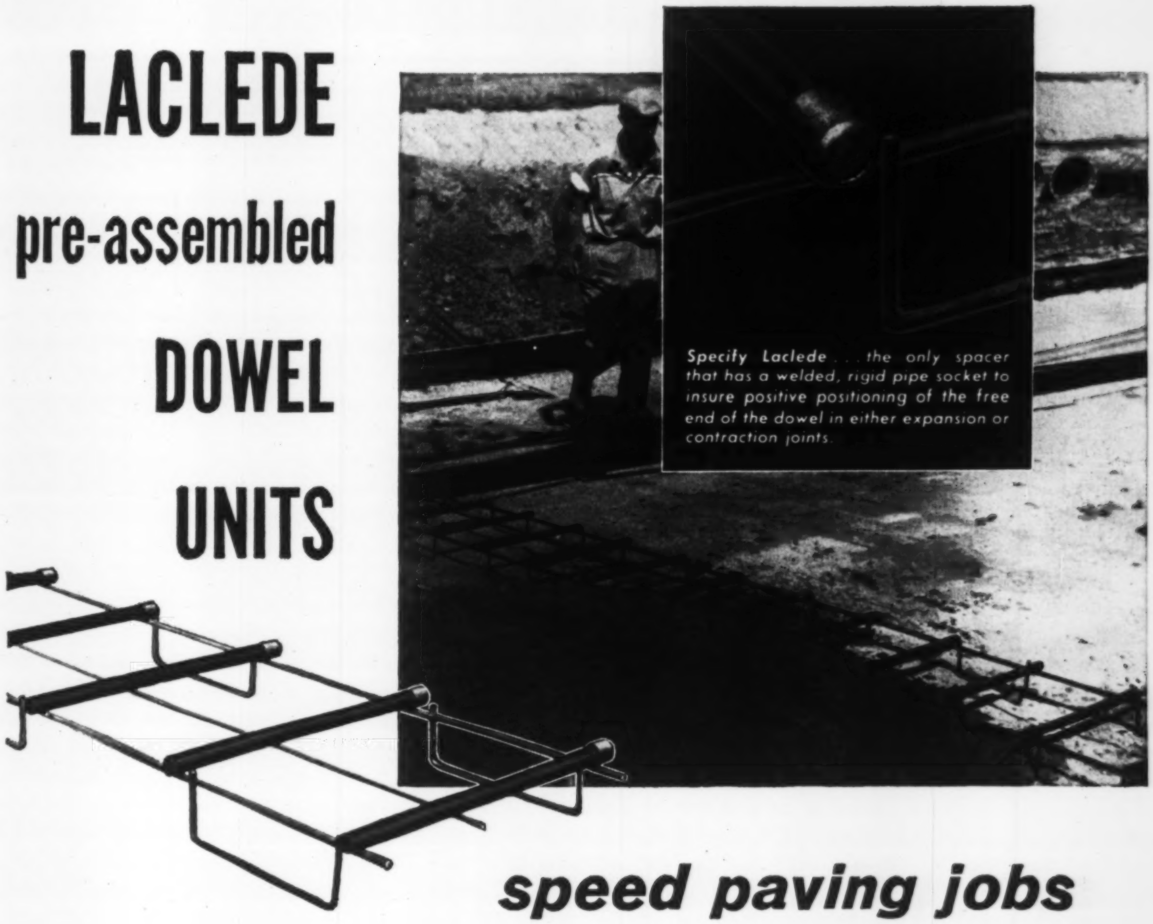

Specify Laclede . . . the only spacer that has a welded, rigid pipe socket to insure positive positioning of the free end of the dowel in either expansion or contraction joints.

speed paving jobs

Expansion sleeves, chairs and spacer bars are all precision shop welded . . . by Laclede . . . into a complete dowel assembly for expansion, contraction and construction joints.

Delivered to the job site in a single, easy-to-handle unit that maintains rigid alignment, Laclede's new dowel assemblies speed paving jobs by cutting installation labor costs. Additional time and money can be saved by specifying Laclede dowel assemblies with dowels shop coated—ready for immediate installation.

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CONCRETE PERFORMANCE REPORT:

POZZOLITH helps Norfolk and Western Railway Company speed tunnel concreting operation and assure maximum durability on 8270-foot tunnel project.

SANDY RIDGE

Sandy Ridge Tunnel—recently completed Norfolk and Western Railway Company project near Carbo, Virginia—is described as the longest railroad tunnel in Virginia or West Virginia.

Constructed to serve new coal mine properties developed by Clinchfield Coal Company, Division of The Pittston Company, the arch-type tunnel represents the major part of a $7 million investment. The project also included the building of 6.3 miles of main line railroad and about 9 miles of spur and operation tracks. A concrete highway bridge and a concrete underpass were built to effect grade separation between the railroad and a highway.

Sandy Ridge Tunnel was constructed from both ends, and, when the tunnel bore had been completed, the concrete floor and ballast walls were poured in order that track could be laid in the tunnel. Track through the tunnel was laid in prefabricated panels and was completed in 3½ days. Approximately 5 miles of track had already been laid north of the tunnel, using material hauled in by trucks. This enabled the Railway Company to give quick service to coal mines developed by the Clinchfield Coal Company. Two train movements a day were maintained through the tunnel during the concreting operation with practically no delays to trains or the contractor's progress.

PLACING OF CONCRETE—The mix was pumped to the top of 27-foot high forms through 6-inch slick lines (foreground), then vibrated into place. POZZOLITH helped provide the exceptional workability required for this type of operation.

The plan was a success—the result of extraordinary teamwork among the mine owners, Norfolk and Western Railway Company personnel, the contractor—and modern advances in concrete technology.

Boring and Mucking Out—Boring of the Sandy Ridge Tunnel began at the south portal on July 3, 1957, and at the north portal on September 27, 1957. The tunnel was holed through on May 17, 1958. During the 10½ months from the start of the initial boring operation until the tunnel was holed through, approximately 190,000 cubic yards of material—mainly seamy sandstone, unstable shale, and coal—were removed.

The unstable nature of material surrounding the bore required installation of steel H-beam supports placed on an average of 4-foot centers. Four-and-one-half million pounds of these structurals were used in the tunnel. In addition, 1-inch steel reinforcing rods were installed on 2-foot centers between the H-beams when the concrete was placed.

Designing the Concrete Mix—Primary requisite for the mix to be used in Sandy Ridge concreting operations was that it develop high early strength—740 psi in 10 hours. This was to permit stripping of each 60-foot steel form so it could be moved to the next position and refilled every 24 hours. A 3,000 psi compressive strength at 28 days was specified.

Exceptionally good workability was also required of the mix to assure successful placing with pumped concrete. And an extremely high degree of concrete durability was necessary to meet the 50 years service life anticipated for the tunnel.

Work on design of the concrete mix to achieve this early form-stripping schedule and meet the other engineering requirements, began six months prior to actual placing of concrete on-the-job.

Norfolk and Western engineers and the contractor, Ralph E. Mills Company, investigated the availability and quality of local materials. One-inch top size Pounding Mill stone and dolemitic sand were decided upon because of their favorable durability record. A Type I cement was selected, and samples of these materials were forwarded to the engineering laboratory of The Master Builders Company in Cleveland, Ohio, where studies were made of the rate of hardening characteristics of concrete with various cement factors and admixture formulations. The rate of hardening test employed was the Bond Pin Pull-Out Method described in ASTM Proceedings, Vol. 57, 1957.

The results of these studies were returned to Norfolk and Western engineers who analyzed the data and selected the following mix. For one cubic yard:

Cement:	517 lbs. (5½ sacks)
Sand:	1485 lbs.
Stone,(1″):	1800 lbs.
Water:	27 gals.
POZZOLITH:	1.375 lbs. (¼ lb. per sack cement)
Calcium Chloride:	11.0 lbs.

This mix performed most satisfactorily and gave sufficiently high strengths (with a margin of safety) to permit 10-hour form stripping at the 60° aver-

NORTH TUNNEL PORTAL—The great difference in elevation on the two sides of the rugged Sandy Ridge Mountain required a 150-foot cut in the north approach to avoid excessive track grade.

THE SANDY RIDGE TUNNEL project was planned and carried out under the general supervision of A. B. Stone, Norfolk and Western Railway Company Chief Engineer (since retired), Walter L. Young, present Chief Engineer, and B. E. Crumpler, Assistant Chief Engineer.

N & W Resident Engineers, C. W. Fiery and W. B. Cole, supervised the building of the tunnel under the direction of Pocahontas Division Engineer, L. A. Durham, Jr.

Contractor for the job was the Ralph E. Mills Company of Salem, Va. and Frankfort, Ky. General Superintendent and Project Manager—J. M. Lipscomb. William Houston was Tunnel Superintendent at the north portal and Richard Bingham at the south portal. Concrete tunnel lining operations were directed by Gus McMullin.

TUNNEL

age temperatures that prevailed in the tunnel.

Mixing and Placing Operations—Concrete materials were dry-batched in 1¼ cubic yard lots then transported to a 2-cubic yard dual power paving mixer at the south portal. The 4-inch slump concrete was finally discharged into rubber-tired dumpcrete bodies for delivery into the tunnel.

Concreting of the floor, curbs and footings proceeded immediately after the tunnel was holed-through. After curing was completed and tracks were laid, the tunnel opened for rail traffic on July 28, 1958—13 months after boring began.

Concreting of the tunnel lining began almost simultaneously at the midpoint of the tunnel and at the north portal. Two specially-fabricated, 60-foot long steel forms were used. Mounted on wheels, they were moved on 85-pound rails laid along the ballast wall.

The form was filled by pumping concrete at a rate of 50 cubic yards per hour. An average of 330 to 400 cubic yards was required for each 60 feet of tunnel lining. The concrete pump was part of a rail-mounted jumbo with two 6-inch diameter slick lines.

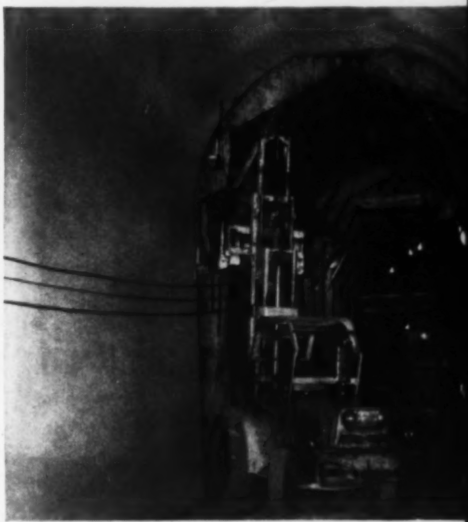
The POZZOLITH concrete mix had excellent coating of the aggregate and maintained its workability throughout the hauling and pumping operations. Only a few minor delays were encountered in pumping the concrete due to blocked lines.

The placing equipment was moved back and forth through the tunnel, alternately filling one form during the day shift and the other during the night shift. Twice daily, the jumbo was completely withdrawn and moved onto a siding to permit the coal-hauling operation previously described.

POZZOLITH and Master Builders Field Service—A total of 61,870 cubic yards of concrete were placed in Sandy Ridge Tunnel. POZZOLITH was used in approximately 50,000 cubic yards of the concrete and helped meet a broad range of engineering requirements. POZZOLITH was not used in the concrete floor and ballast curbs in the tunnel. Compressive strengths that permitted 10-hour stripping of forms were easily and economically achieved with a combination of POZZOLITH and calcium chloride. Other benefits resulting from POZZOLITH included reduced shrinkage and cracking, lower permeability and increased bond to steel.

From early planning through completion of the job, Master Builders field men and the Company engineering staff worked with the contractor to achieve uniform, superior quality concrete at lowest cost-in-place.

To better meet concreting requirements on your current and future projects—call in the local Master Builders field man. At no cost, he'll demonstrate—with your materials—how concrete produced with POZZOLITH becomes a more versatile and more useful building material . . . superior in performance, in quality and in economy to plain concrete or concrete produced with any other admixture.



FORM STRIPPING—In spite of forms being stripped every 10 hours, this work was carried out with no interruptions to coal shipments through the tunnel. Smooth, crack-free concrete surfaces required almost no finishing.

The Master Builders Company, Cleveland, Ohio • Division of American-Marietta Company
The Master Builders Company, Ltd., Toronto, Ontario
Represented in foreign countries by:
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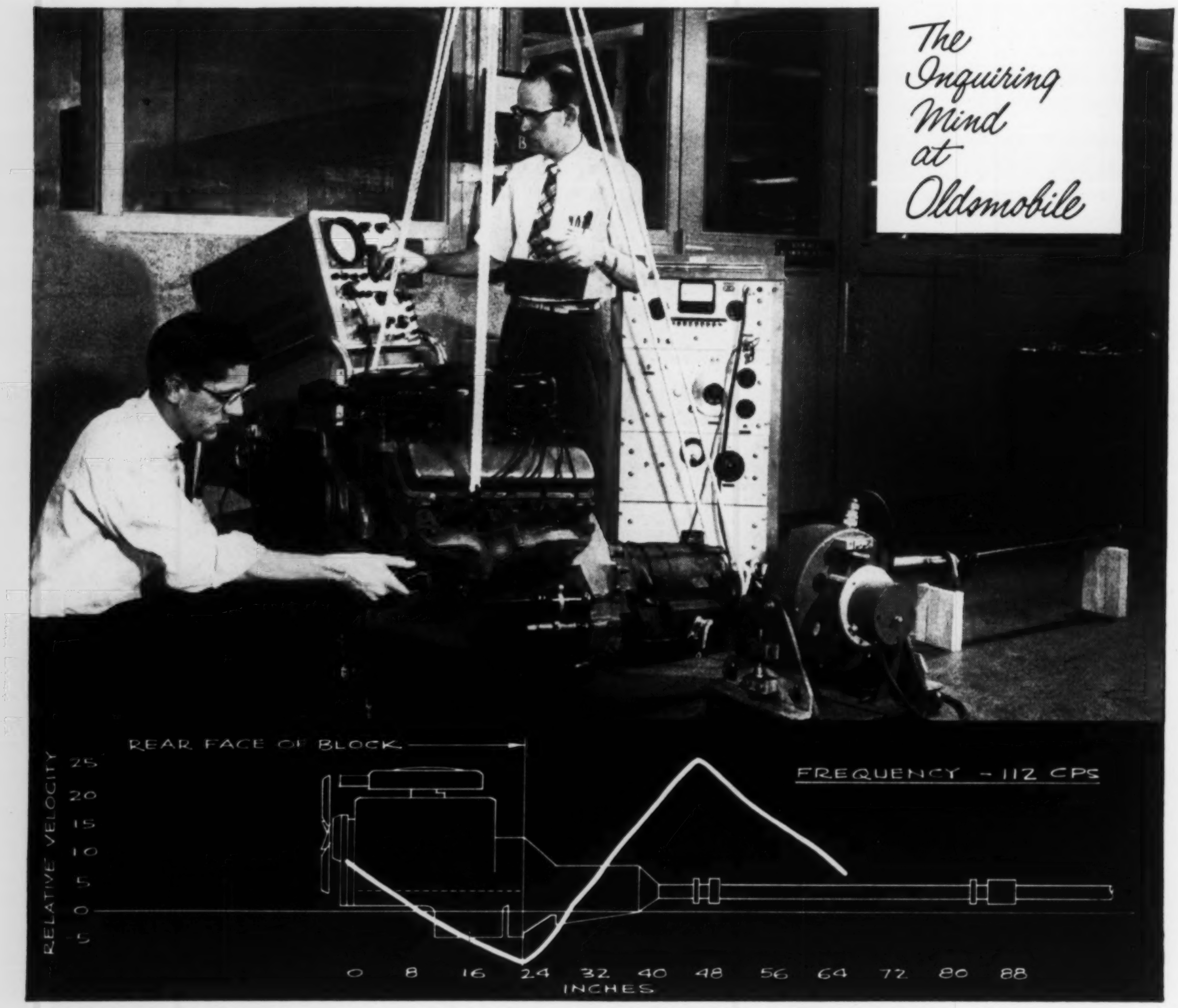
*POZZOLITH *is a registered trademark of The Master Builders Co. for its concrete admixture to reduce water and control entrainment of air and rate of hardening.*



no. 11 OF A SERIES

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Intricate vibration studies that determine proper engine mounting points help Oldsmobile engineers design smooth, balanced Rocket Engine power.

To tame the explosive fury of the modern high compression engine, Oldsmobile engineers have developed highly specialized techniques in the field of vibration studies. The results of these studies produce Rocket Engine power that is balanced, controlled and exceptionally quiet under nearly every operating condition. Vibrations caused by the multitude of explosions in the cylinders—4800 per minute at 30 mph—are almost imperceptible in the passenger compartment.

To thoroughly study an engine's "bending" characteristics, in both horizontal and vertical planes, the engine is suspended from a low spring rate nylon rope that isolates external interference. A shaker is used to excite the entire power plant and drive line to find the resonant vibration frequencies, generally in the 25 to 55 mph speed range. Then intensive analysis of the engine begins. At four inch intervals, a transducer in contact with the engine translates movement into a reading on an oscilliscope. From this information, a displacement curve is plotted showing exactly the ideal locating points for the engine mountings—the "nodal points".

In addition, each engine accessory—generator, air cleaner, power steering pump, etc.—is studied so that no undesirable resonant vibrations will occur.

The quiet power, brilliant performance and solid quality of the 1960 Oldsmobile is a tribute to modern technology and craftsmanship. There's never been another car like it! Visit your Quality Dealer soon and Quiet-Test Olds for '60.

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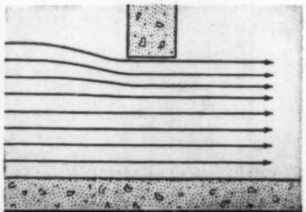
HY-Q SLUICE GATES WITH FLUSH-BOTTOM CLOSURE
and get these **6** design advantages

HY-Q® Sluice Gates Mean Construction Economies

Because of the improved flow characteristics of the Rodney Hunt HY-Q sluice gate, a given volume of flow can be handled with a smaller gate size, narrower channel and lower channel walls than are required for a conventional gate. Thus there are often substantial economies effected in concrete construction. This improved flow is the direct result of the 5 other design advantages of the Rodney Hunt HY-Q sluice gate:

#1



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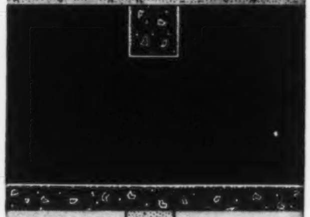

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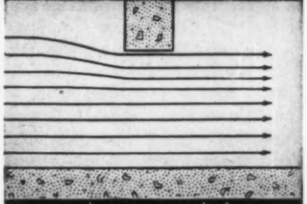

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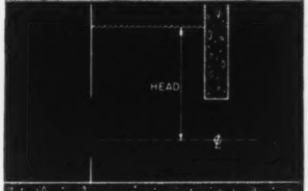

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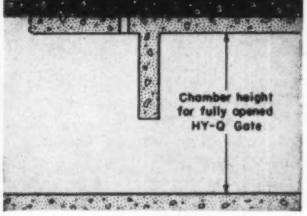


#1 HY-Q Sluice Gates Assure Maximum Flow

#2 HY-Q Sluice Gates Assure Complete Drainage

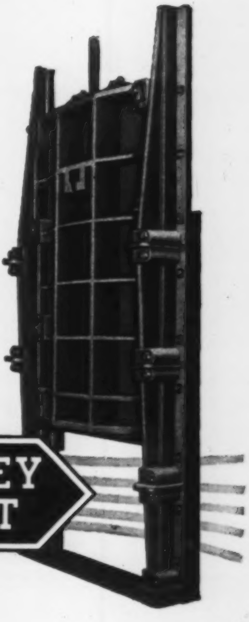
#3 HY-Q Sluice Gates Eliminate Interference with Flow

#4 HY-Q Sluice Gates Assure Maximum Hydraulic Gradient

#5 HY-Q Sluice Gates Permit Lowest Possible Invert

All these advantages derive from the design of the resilient seal fastened to the bottom of the disc. The seal extends the full width of the disc and provides a cushioned closing at the stop bar flush with the invert.

The HY-Q gate offers unmatched design flexibility and construction economy for water control projects . . . with hundreds of gate sizes available from 6" x 6" to 144" x 144" and larger to meet your specific design requirements.



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BY-LINE WASHINGTON . . . . .

The largest share of that $58.8 million allocated by the FAA for fiscal 1961 airport aid is to be spent for construction of runways, taxiways, and aprons at some 314 airports. (Sponsors match federal funds on a 50-50 basis.) Runway construction will account for $24 million; taxiways and aprons, for $21.2 million. Of the remainder, $6.2 million will go for land acquisition—mostly to obtain "clear areas" at the ends of the runways.

* * *

A bill (HR 9586), tossed into the Congressional hopper by Missouri's Representative Moulder, would require flatly that alternate specifications be prepared for "portland cement concrete and asphaltic concrete of comparable design" for all highway work in which federal funds are involved. Thus, a consultant's, or highway department's opinion, as to which type of pavement best meets the project requirement would be subordinated to lowest bid price. (Incidentally, few give the bill much chance of action this session, but the fact that it's been introduced at all is evidence of some Congressional thinking on the matter.)

* * *

Professionals—architects this time—lost very badly on one Washington front, when a House appropriations subcommittee okayed preparation of standard plans and specifications for Indian Bureau schools and other buildings, by Bureau staff architects and engineers. Architects (March issue, page 94) had protested strongly, insisting that such standard plans are uneconomic. Most annoying to architects was the Bureau's proud report that it had achieved savings by drastically cutting down classroom and dormitory space per child, eliminating covered outdoor spaces and multi-purpose rooms, shaving other requirements to such a point that (in the Bureau's own words), "Any further reductions would result in substandard structures."

* * *

The problem of air pollution is sure to get a thorough airing through the remainder of this year and for several years to come. A new Senate bill (S 3108), introduced by California's Kuchel, provides for extended public hearings into the matter by the U. S. Surgeon General. The bill would also extend the life of the existing law beyond the expiration date of July 1, 1960, and remove an existing limit of $5 million on annual appropriations for studies of the problem. There seems little doubt that Congress will approve.

* * *

The Corps of Engineers will get one bit of new authority it has asked for this year, will not get a second. Almost certain of approval is authority to make studies of river flood-plains, and to give official warnings to local communities that construction in certain areas is subject to flood damage, the implication being that any subsequent work would have a hard time getting government aid if it was damaged by floods. But Congress probably will not accept the Corps' suggestion that "one-shot" appropriations be made for future civil works projects, despite the obvious savings. The problem is that one major long-term project (like Oregon's $400-odd million John Day Dam) could unbalance the entire federal budget.

There will be no new stream-pollution legislation this year, despite the vehement speeches of proponents, after the House failed to override a Presidential veto late in February. Congress passed a compromise measure (HR 3610) calling for a $90 million annual program of federal grants to communities for pollution control works, despite Mr. Eisenhower's request for only $20 million for the program for fiscal 1961. As expected, the President promptly vetoed the new bill, and Congress did not override the veto. Failure of the new bill still leaves on the books the three-year-old law that authorizes federal grants of up to $50 million yearly.

* * *

Although no civil engineers were included in preliminary lists of witnesses, there's a lot of construction interest in those hearings that began late last month (March 22) into "Frontiers of Atomic Energy Research," before the Senate-House Joint Committee on Atomic Energy. First subject up for discussion was "Project Plowshare," which would include (among other matters) the use of nuclear energy for excavation, energy production, desalinisation of water.

* * *

On atomic matters, there were these additional developments: The Atomic Energy Commission let a contract (to Cleveland Pneumatic Industries, Inc.) for a year-long survey of two Pacific Ocean areas where low-level radioactive wastes have been dumped since 1946, to see what, if anything, has been the result. It is reported that scientists are now working out new techniques for exploring underground water resources, following down traces of tritium picked up by rainwater from fallout in nuclear bomb tests.

* * *

Neither engineers nor architects are included in membership of a 15-man committee set up by the U. S. Public Health Service and the American Hospital Association, to develop principles for community-wide health facility planning. One of the principal functions of the committee, said the USPHS, is "to develop plans for improved hospital services and facilities, especially in metropolitan areas."

* * *

At least $180 billion must be spent by federal, state and local governments over the next 20 years, if the nation's water resources are to keep pace with economic and population growth. That's the opinion of Senator Robert S. Kerr, chairman of the Senate Select Committee on Water Resources, after nearly a year of committee investigations.

* * *

The Supreme Court's decision that permitted the Power Authority of the State of New York to take some 1,383 acres of Tuscarora Indian land near Niagara Falls turned on a single legal point: The court held that Indian reservations owned by the U. S. government couldn't be taken. But the Tuscarora tribe actually bought the land in question (in 1804) and the tribe—not the federal government—held title. Hence, said the court, prohibitions against taking the land don't apply.

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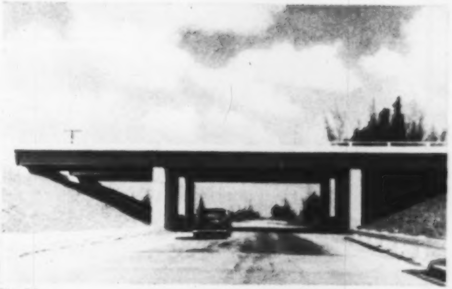

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For twenty-five years, Armco FLEX-BEAM® Guardrail has been installed at danger spots on highways all over the country. Photos shown here are representative of the nation-wide use of this deep-beam guardrail.

As a motorist and engineer, you are interested in the safety of the guardrail protecting our highways. With Armco FLEX-BEAM, each installation serves as a continuous beam, reducing the chances of dangerous "pocketing" behind the posts. If vehicles strike the guardrail, its high beam strength helps direct the car parallel to the rail.

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For literature on Armco FLEX-BEAM Guardrail, ask your local Armco Sales Engineer—or write us. Armco Drainage & Metal Products, Inc., 5870 Curtis Street, Middletown, Ohio.

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News Briefs . . .

February Construction Costs Down Less than Seasonally

The value of new construction put in place in February 1960 amounted to $3.6 billion, according to preliminary estimates of the Bureau of the Census of the U. S. Department of Commerce. Though this was 4 percent below the January 1960 level, it was less than the normal seasonal decline between January and February and 2 percent above the February 1959 value. The total value of construction expenditures in the first two months of 1960 amounted to $7.3 billion, topping the comparable 1959 total by 1 percent.

New private construction expenditures in the February just passed amounted to $2.7 billion, 3 percent less than in January but 7 percent above February 1959. The January-to-February decline was less than the normal seasonal change for the period. Spending for private residential construction declined by less than the normal seasonal change to $1.4 billion. This was 7 percent less than in the preceding month but 2 percent over the February 1959 level. The total value of private construction put in place in the first two months of 1960 was $5.4 billion, 7 percent above the total for the comparable period in 1959. Each major type of private construction shared in this over-the-year advance, including residential buildings, for which outlays increased 2 percent to $2.9 billion, and nonresidential buildings, for which spending rose 18 percent to $1.5 billion.

Total new public construction expenditures in February 1960 amounted to $0.9 billion, 7 percent less than in January 1960 and 12 percent below the February 1959 level. Each major type of public construction, with the exception of residential buildings, shared in the January-to-February decline. However, in each case except highways the decrease was less than the normal seasonal change. Public construction expenditures in the first two months of 1960 totaled $1.9 billion, a 12 percent drop from the total in the same period of 1959. Most types of public construction contributed to this decrease.

Deep Cofferdam Built for New Navy Drydock

Unusual deep-water cofferdam, nearing completion at Puget Sound Naval Shipyard, requires some of the longest steel sheetpiling ever used in construction. Specially fabricated and furnished on a rental basis from the Los Angeles office of the L. B. Foster Company, the MP-101 sheetpiles are nearly 100 ft long. The huge cofferdam extends about 1,200 ft into the Sound, terminating in about 60 ft of water. When dewatered later this year, it will provide a site for construction of a new carrier-repair drydock. The contractor is Manson-Jones-Perini-Osberg, a joint venture group. Work is under the District Public Works Officer of the 13th Naval District, Seattle, Wash.

Colorado River Aqueduct To Be Completed in May

Ceremonies marking the completion of the work of bringing the Colorado River Aqueduct to its full planned delivery capacity have been postponed to May 11 from a tentative date of January 28. As part of the ceremony a companion plaque to the original plaque will be installed at the West Portal of the San Jacinto Tunnel. The original plaque was installed in 1939 during ceremonies marking the completion of the main aqueduct in its original development.

The May 11 celebration will mark the completion of work to bring the Colorado River Aqueduct to its planned daily capacity of more than 1 billion gallons of water. This is approximately double the initial capacity of the aqueduct, and is the result of a $200 million expansion program initiated in 1952.

Completed construction work on the main aqueduct includes the installation of six additional pumps in each of the five pumping plants on the aqueduct, enlargement of the pumping plant buildings, the installation of two additional pump delivery lines at each plant, and the construction of about 25 miles of canals and pipe siphons. Other work completed under the expansion program includes Garvey Reservoir, now in operation, and the construction of over 100 miles of pipelines and tunnels to expand the distribution system. The enlargement of Lake Mathews, from 107,000 acre-ft to 182,000 acre-ft, will be completed by the end of 1960.

Italy to Build Many New Roads

The Italian government announces the start of an ambitious new road development program, which will include the expenditure of $480 million for expressways. Two of the proposed expressways, slated for completion this year, will link Bescia and Padova and Torino and Ivrea. Another project, currently getting underway, will connect Fornara and Pontremeli. Widening of the Padova-Mestre and Naples-Bari highways is included in the program.

A number of the new roads will be built with an eye to providing scenic tourist routes and joining present tourist areas. Parks to the north and west of Rome will be joined to other roads, and a scenic coastal highway will be built between the mouth of the Tiber River and Naples.

Glen Canyon Powerhouse—in Model

Model of the Glen Canyon Powerplant, on exhibit in the Bureau of Reclamation's Engineering Laboratories in Denver, is viewed by E. R. Schultz (center), F. ASCE, head of the Bureau's Concrete Dams Section, and L. F. Wylie (left), F. ASCE, and V. E. Larson, M. ASCE, respectively project construction engineer and assistant project construction engineer of the Glen Canyon Unit at Page, Ariz. The huge powerplant is under construction on the Colorado River Storage Project in northern Arizona. The engineers took part in the Bureau's Sixth Construction Engineers' Conference, held at the Reclamation Center in Denver.

South American Study

Ralph W. Booker, F. ASCE, of R. W. Booker and Associates, consulting engineers of St. Louis, recently signed a contract in Mendoza, Argentina, for an extensive study of technical, economic, and financial aspects of a public works program contemplated by the Province of Mendoza in western Argentina. Associated with the Booker organization as joint venturers are two other firms—the Tellepsen Construction Company, of Houston, Tex., and Smith, Hinchman & Grylls Associates, Inc., Detroit architects and engineers.

The Province of Mendoza, which has an area about that of the states of Indiana and Illinois combined, is considering the conversion of revenues from its oil resources into a program of public works that will support its growing industrial and agricultural economy. The first stage of the study will take about nine months and will include recommendations for the construction of dams, hydroelectric power plants, electric power transmission lines, irrigation systems, roads and bridges, and public buildings.

Four New Launching Bases for ICBM Chosen

Launching sites for four additional intercontinental ballistic missile bases have been announced by the U. S. Air Force. This completes the list of thirteen Atlas squadrons in the current program.

The four new launching locations are Altus Air Force Base, Oklahoma; Dyess Air Force Base, Abilene, Tex.; Walker Air Force Base, Roswell, N. M.; and Plattsburgh Air Force Base, Plattsburgh, N.Y. Each will have ten missiles.

The estimated construction cost of each of the four missile-launching complexes is $47,000,000. Completion is scheduled within the next two years.

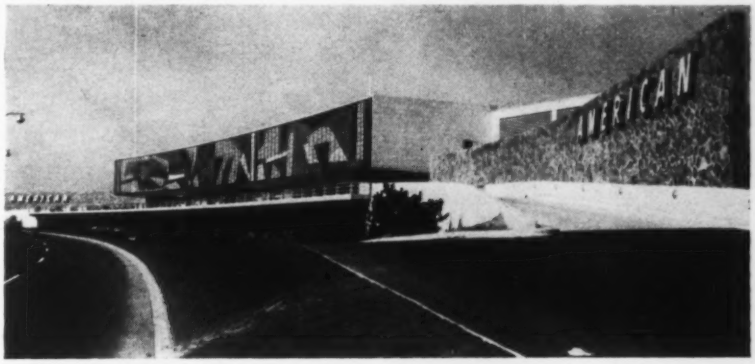
American Airlines Terminal Features Passenger Comfort

Modern materials and up-to-the-minute designs have enabled American Airlines to build its new $14,000,000 Jet Passenger Terminal at New York International Airport for maximum passenger comfort and convenience. The unique new "customer-centered" terminal was planned around the passenger rather than the airplane, the traditional approach to air terminal construction. From his first view of the block-long (317-ft) stained glass window to the movable jetways connecting the departure lounge and the airplane, the passenger will be subtly guided on a step-saving route.

The terminal's split level feature is designed to separate the incoming and outgoing passengers, thus avoiding the confusion often found when departing and arriving airplanes are at a terminal at the same time. The upper level is for inbound passengers and contains ticket counters, main concessions, restaurants, jet departure lounges, waiting rooms and baggage check-in points. The lower level is designed to get the passenger and his baggage together in the shortest possible time and to assure that both are provided with transportation to the destination point with a minimum of confusion.

Structural engineers for the new jet age terminal were Sverdrup, Elstad, Krueger Associates, and the mechanical engineers Jaros, Baum and Bolles. The architects were Kahn and Jacobs, and the builder the Turner Construction Company.

Tremendous expanse of stained glass, 317 ft long and almost 23 ft high, lends distinction to American Airlines new "customer-centered" passenger terminal at International Airport. Revolutionary passenger service techniques have been built into the terminal.



Recent attempts to save the Hawaiian village of Kapoho from a flow of red hot lava proved futile despite round-the-clock efforts of a 23-machine fleet of tractor-bulldozers. Efforts to prevent lava from reaching the town were abandoned when the lava, issuing at an estimated rate of 5.1 million cu yd daily, broke through two diversion dikes and halted work on a third. However, the dikes did gain time for Kapoho inhabitants to evacuate the town. In ten days the equipment spread, mobilized from a 90-mile radius, had dozed up nearly 2.5 miles of dike, ranging from 20 to 30 ft in height and nearly 100 ft wide at the base. More than 400,000 cu yd of dirt was involved. Photo courtesy Caterpillar Tractor Co.

Earth Dikes Fail to Save Hawaii Town from Lava Flow

Arched Aluminum Roof Protects Reservoir Supply

Aluminum-arch roof of unusual design covers Stump Hill Reservoir at Pawtucket, R. I., keeping the water in the 20,000,000-gal storage tank cooler and cleaner. Charles A. Maguire & Associates, Providence, designed the roof so that each 16½-ft-long sheet would span 15 ft. The arching action not only adds strength (the roof can support 30 psf), but it more than doubles the unsupported span of the aluminum sheet, making for considerable savings in framing. Gutters between arches are grouted with cement. Sheet was fabricated and erected by the Elwin G. Smith Company, of Pittsburgh. Kaiser Aluminum & Chemical Sales, Inc., supplied the aluminum sheeting.

Mammoth Pool Project Yields First Power

The first generating unit of the Southern California Edison Company's $50,000,000 Mammoth Pool Project was put into operation on February 18, virtually completing one of the West's great hydroelectric projects. Mammoth Pool's second unit is expected to be put into service in a few weeks, according to James F. Davenport, executive vice president of the Edison Company.

The Mammoth Pool project is the newest addition to the company's intensive development of its Big Creek-San Joaquin River hydroelectric system in the High Sierras. Conceived in the 1890's the multi-purpose power project has been developed during the past half century with a total investment of approximately $212,000,000. It has involved the construction of fourteen dams and eight powerhouses and the making of six major lakes.

Mammoth Pool's two units will have a maximum electric generation capacity of 150,000 kw. Power from them will be fed into the Southern California Edison system which serves customers in Central and Southern California.

The water which turns the turbines comes to the powerhouse through an eight-mile tunnel, which was cut through solid rock from the Mammoth Pool lake upstream. To create the lake, one of the world's highest rolled earth-fill dams was constructed (450 ft from bedrock). Behind the 30-story-high dam, a new lake with a capacity of approximately 123,000 acre-feet is now filling, and will be available for recreational use this summer.

The Mammoth Pool project was begun in January 1958. Contractors for the work were the Bechtel Corporation, the Utah Construction Company, Morris-Knudsen, Inc., and Kaiser Engineers.

New Tire Plant for B. F. Goodrich Company

This spring the B. F. Goodrich Company, with headquarters at Akron, Ohio, will begin construction of a multi-million-dollar tire manufacturing plant near Fort Wayne, Indiana. To be built on a 350-acre tract on the banks of the Maumee River, the 850,000-sq ft facility will be the sixth in the company's chain of tire plants in the United States. When it is in full operation, it will employ about 1,000 men.

In design for more than three years, the structure will be the most modern, up-to-date tire plant in the world. It will include the latest applications of automation and will stress precision quality control methods. It is designed to permit straight-line production throughout the plant, with raw materials entering at one end of the building and emerging at the other as finished products. The new plant was engineered and designed by the B. F. Goodrich Engineering Department.

Capacity of Golden Gate Bridge to Be Studied

A four-month study to determine the feasibility of running high-speed rapid transit vehicles across the Golden Gate Bridge will be conducted by D. B. Steinman, F. ASCE, New York City consulting engineer and bridge authority. A rapid transit route between San Francisco and Marin County is a key link in the five-county, 125-mile rapid transit system that has been proposed for the Bay area.

World Trade Center Planned for New York

A World Trade Center may be built on a 13½-acre tract along the East River, adjacent to New York's downtown financial district. As proposed by the Downtown-Lower Manhattan Association, the $250,000,000 project would include a combination office and hotel 50 to 70 stories high, a six-story international trade mart and exhibition hall, and a central securities exchange building. The center would be part of a billion-dollar downtown redevelopment program submitted by the Association in October 1958.

The new buildings would be constructed on a three-story masonry platform. The platform would have a landscaped promenade with a view of the river. The interior of the platform would be an arcade, five blocks long, linking private housing projects now in the planning stage under the federal-city slum-clearance program. A theater, restaurants, and shops would line the arcade.

At a session at which the Downtown-Lower Manhattan Association outlined the development program, it was pointed out that visiting businessmen, arriving by helicopter from the airports to the helioport that the city is building near the site of the Trade Center, could transact business in the offices and then spend the night in the hotel.

Mayor Wagner sees the plan as "a great asset to the city and important to the world," but noted that many details must be worked out. The Port of New York Authority has been requested to make detailed studies on the financing, building, and operation of the center.

Mechanical Engineer to Be New President of E.I.C.

The Engineering Institute of Canada has announced the election of George M. Dick, a mechanical engineer of Sherbrooke and Montreal, as president for 1960-1961. He will be inducted into office at the Institute's 74th annual meeting, to be held in Winnipeg in May. Since 1952 Mr. Dick has been chief engineer for the entire Ingersoll-Rand organization in Canada. He will succeed J. H. Hanna, of Calgary, Alberta, as president.

With fifty branches located in all the provinces and an active membership of over 20,000, the Institute is believed to be Canada's largest professional society.

Good Will Engineering Tour of South America

A husband-and-wife team of engineers is following in the footsteps of President Eisenhower with a tour of five Latin American countries to explore ways of bettering relationships between North and South American engineers and technicians. The engineering ambassadors are Rodney D. Chipp, director of engineering for Communications Systems, Inc., and his wife, Dr. Beatrice A. Hicks, president of the Newark Controls Company. They were selected for the role of "people-to-people ambassadors" for the engineering profession by the National Society of Professional Engineers from among more than 2,000 candidates.

The couple will confer with U.S. and Latin American businessmen, engineers, university deans, heads of engineering firms, engineering society officials, and government officials in Brazil, Uruguay, Argentina, Chile, and Peru.

According to Paul H. Robbins, executive director of the NSPE, "American engineering personnel are playing an interesting role in foreign fields, and this is probably more the case in South America than anywhere else." He also said that the objective of the tour is "essentially that of improving the professional capabilities and outlook of United States engineers working in South America."

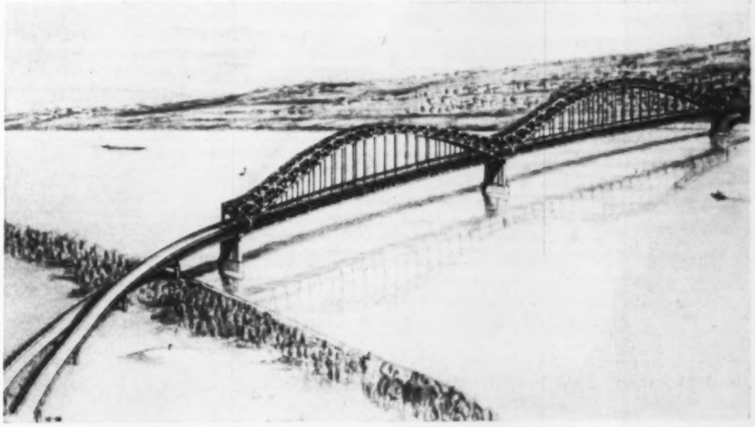
Research Financed By Federal Agencies

A 1960 guide to Government grants and contracts in research has been issued by the Social Legislation Service as Document 14. The publication, entitled "Federal Agencies Financing Research," is designed to guide interested persons directly to the federal agency or bureau that may best utilize his special abilities. Over half the $3,000,000,000 spent annually for federal research is for work to be performed extramurally through grants or contracts. The detailed Index lists scientific fields and indicates the agencies sponsoring extramural research in each.

Copies of Document 14 may be obtained from the Social Legislation Information Service, 1346 Connecticut Avenue, N. W., Washington 6, D. C. The selling price is $1.00.

Unique Bridge to Connect Indiana and Kentucky

Artist's sketch released by Indiana State Highway Commission shows double-deck, steel superstructure of projected Ohio River bridge between New Albany, Ind., and Lexington, Ky., the first new bridge between the two states in twenty years. According to the engineers, Hazelet & Erdal of Louisville, the structure is a unique tandem, tied arch double-deck design that requires fabrication methods used for only one other bridge—the cantilever truss bridge over Carquinez Strait. The bridge will be built by the R. C. Mahon Company, of Detroit, under a $5.4 million contract. Total cost of the bridge and its approaches will be $15 million.



Roundup of Transportation Studies

Renewed interest in the national highway program is indicated by a number of transportation studies currently underway or recently completed. Studies that could have an important effect on the national transportation policy have been summarized by the University of California Institute of Transportation and Traffic Engineering at the request of the ASCE Coordination Committee on Transportation. The summaries are briefed here.

Department of Commerce Study

The Department of Commerce Study, the substance of which may be made public in the near future, was made under the general direction of Under-Secretary of Commerce for Transportation, John J Allen. The report, concerned with transport economic policy, has been submitted to the White House. Under-Secretary Allen is reported to have stated that basic problems to be discussed in the report include: concepts of regulatory needs, subsidies, employee benefits, taxation, and government as a transport buyer and operator. Presumably some or all the recommendations will be transmitted to this session of Congress.

The study was authorized by The Congress following the passage of the Transportation Act of 1958. Dr. Ernest Williams of Columbia University was the director. Eight survey areas were delineated for study, and a contractual arrangement was made with outside consultants to cover each of them.

The American Trucking Association and the American Waterway Operators have issued statements condemning the Commerce study, apparently assuming that it will favor greater freedom in rate-making, closer attention to the cost factor in rate regulation, and widespread imposition of user charges.

According to Dr. Williams, "We know very little, statistically or quantitatively, about a very large part of our transportation system. I would hope that we [the study] may show that it is necessary for us to pursue our search for better techniques to improve transportation and to show that the present government setup is not designed to develop a sound general transportation policy."

Blatnik Committee Study

In connection with the national highway program, a Select Subcommittee of the House of Representatives Public Works Committee was created on September 4, 1959 ". . . in view of the magnitude of the program, increased cost problems, and information received by the Public Works Committee alleging deficiencies, wasteful extravagance and disregard of public sentiment in routing portions of the Interstate System." This committee is under the chairmanship of Representative John A. Blatnik (D Minn) and is expected to conduct staff investigations as well as to hold hearings. Hearings in early February 1960 were devoted to the subject of the new 16-ft minimum standard for vertical clearances on the Interstate System and related defense aspects of the highway program.

"Senate Resolution 29" Study

The study was authorized for the Senate Committee on Interstate and Foreign Commerce during the 1958 session. Practically nothing was done between 1958 and 1959. In 1959, $290,000 was appropriated for the Committee, and Gen. John P. Doyle was appointed director of the professional staff. An "industry advisory" staff was also set up, headed by Dr. George Baker of Harvard.

In its first phase, the study will explore and evaluate what has been done, to help gain an overall view of transportation. Subsequently, the study "will explore the actual implementation of the national transportation policy. . . ." Generally, this study appears to be laying much more stress upon coordination than competition and seems likely to be more acceptable to the for-hire motor carriers.

White House Study

At the direction of President Eisenhower, a study is now being conducted by Special Assistant to the President, Gen. John S. Bragdon. Its subject is reported to be a comprehensive review of federal highway policies and of the Interstate Highway Program, especially with respect to federal, state, and local responsibilities for planning, supervising, and financing the program. It is expected that this study will develop recommendations concerning the pay-as-you-go basis for the road program, and will look particularly at federal responsibility for road development in urban areas. A report on this study is expected in the spring of 1960.

Comptroller General's Investigations

Under powers of audit of the operations of departments of the federal government in the expenditure of federal funds, the Comptroller General's office has been making investigations of the conduct of the federal road programs. In a report rendered to Congress and to the Federal Highway Administrator in May 1958, the Comptroller General looked into the basis for and uniformity of cost estimates made by selected states for the National System of Interstate and Defense Highways. In this report questions were raised concerning standards of design.

Out recently [December 1959] is a report of a review of the federal-aid highway program in BPR Region 2 and of the efficiency of expenditure of federal-aid funds in the states of Maryland, West Virginia and Pennsylvania. Here questions were also raised concerning the basis for employment of consulting engineering firms.

"Section 210" Study

Probably one of the most extensive studies to be undertaken to date in connection with the federal interest in highway development is the one called for under Section 210 of the Federal Highway Act of 1956. The study, due in January 1961, covers many aspects of highway development and the report should contain much improved technical information for current and future highway planning.

The purpose of Section 210 was declared to be to make available to Congress "information on the basis of which it may determine what taxes should be imposed by the United States, and in what amounts, in order to assure, in so far as practicable, an equitable distribution of the tax burden among various classes of persons using the federal-aid highways or otherwise deriving benefit from such highways." It calls for a study of the effects on design, construction, and maintenance of the federal-aid highways of the use of vehicles of various weights and dimensions and of the frequency of occurrence of such vehicles in the traffic stream. The AASHO Road Test, being conducted at Ottawa, Ill., is designed to furnish information on this requirement.

Committee on Urban Transportation

In order to develop a factual basis for studies of transportation needs in urban areas, a National Committee on Urban Transportation was formed in May 1954. This committee, a voluntary association of many organizations and individuals interested in better transportation planning for cities, undertook the preparation of a series of guide manuals which would serve as the basis for undertaking comprehensive practical studies. The substance of these manuals was tried out in a number of "pilot" cities before the manuals were issued in final form. Among the "pilot" cities for which notable transportation studies have been completed are San Diego, Phoenix, Detroit, and Nashville. The general introduction, "Better Transportation for Your City," and the manuals are available from the Public Administration Service, 1313 E. 60th St., Chicago 37, Ill. A few of the titles are "Origin-Destination Survey," "Origin-Destination and Land Use," and "Conducting a Comprehensive Parking Study."

Metropolitan Area Studies

In recent years notable large-scale comprehensive transportation studies have been undertaken in several large metropolitan areas. Special study staffs were assembled for the work. Generally they involved extensive cooperative effort between the cities, counties, and

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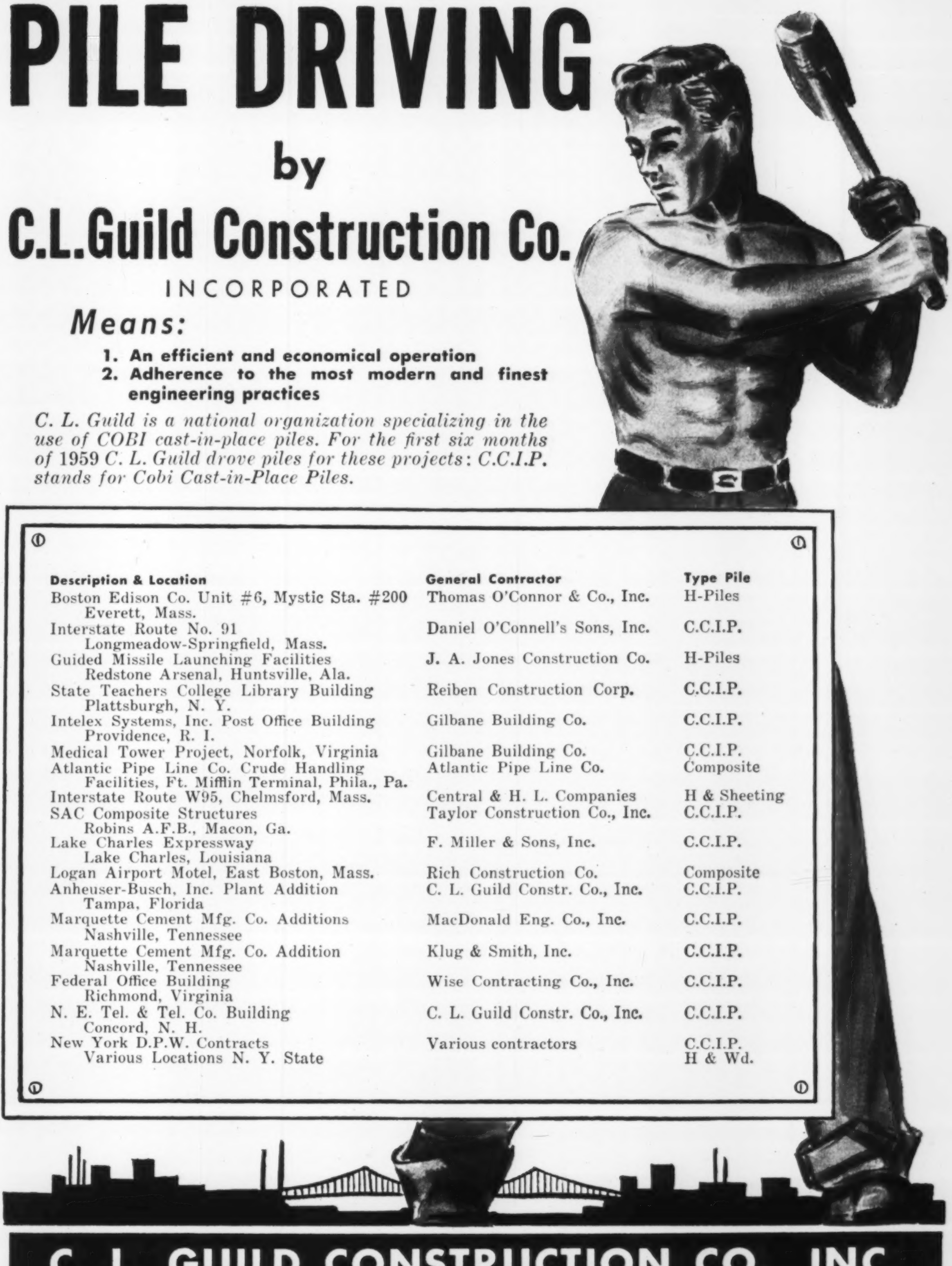

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Interstate Route No. 91 Longmeadow-Springfield, Mass.	Daniel O'Connell's Sons, Inc.	C.C.I.P.
Guided Missile Launching Facilities Redstone Arsenal, Huntsville, Ala.	J. A. Jones Construction Co.	H-Piles
State Teachers College Library Building Plattsburgh, N. Y.	Reiben Construction Corp.	C.C.I.P.
Intelex Systems, Inc. Post Office Building Providence, R. I.	Gilbane Building Co.	C.C.I.P.
Medical Tower Project, Norfolk, Virginia	Gilbane Building Co.	C.C.I.P.
Atlantic Pipe Line Co. Crude Handling Facilities, Ft. Mifflin Terminal, Phila., Pa.	Atlantic Pipe Line Co.	Composite
Interstate Route W95, Chelmsford, Mass.	Central & H. L. Companies	H & Sheeting
SAC Composite Structures Robins A.F.B., Macon, Ga.	Taylor Construction Co., Inc.	C.C.I.P.
Lake Charles Expressway Lake Charles, Louisiana	F. Miller & Sons, Inc.	C.C.I.P.
Logan Airport Motel, East Boston, Mass.	Rich Construction Co.	Composite
Anheuser-Busch, Inc. Plant Addition Tampa, Florida	C. L. Guild Constr. Co., Inc.	C.C.I.P.
Marquette Cement Mfg. Co. Additions Nashville, Tennessee	MacDonald Eng. Co., Inc.	C.C.I.P.
Marquette Cement Mfg. Co. Addition Nashville, Tennessee	Klug & Smith, Inc.	C.C.I.P.
Federal Office Building Richmond, Virginia	Wise Contracting Co., Inc.	C.C.I.P.
N. E. Tel. & Tel. Co. Building Concord, N. H.	C. L. Guild Constr. Co., Inc.	C.C.I.P.
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state concerned and federal government. The Detroit Area study, begun in 1955, has been completed and reported upon. The Chicago Area study has been completed, and the final report is in process of publication. The Pittsburgh and Philadelphia Area studies are currently underway.

Worth noting, also, is the "Transportation Plan, National Capital Region," issued by the U. S. National Capital Planning Commission in 1959. According to the letter of transmittal, the survey was "a complex task requiring the integration of the efforts of many organizations and individuals." Harland Bartholomew, F. ASCE, chairman of the Commission, stated that "advanced and extensive research has been applied to the transportation problems of the National Capital Region. We believe the survey is one of the most thorough transportation analyses ever completed in any American city. The transportation system recommended for the National Capital Region will consist of an expanded network of highways and new express transit facilities."

The Vancouver (B. C.) Technical Committee for Metropolitan Highway Planning has issued several reports since 1956. Subjects covered include: population and land use forecasts, motor vehicle travel analysis and forecast, transit planning study, arterial highway needs study, engineering studies on route location, testing and evaluation of alternative arterial highway systems, and state development study.

USPHS Awards Grant for Study of Sewage Ponds

Washington State University's Sanitary Engineering Research Section is starting a three-year limnological study of anaerobic-aerobic sewage ponds under a grant from the U. S. Public Health Service. Prof. G. H. Dunstan, F. ASCE, head of the sanitary engineering laboratory and principal investigator under the grant, has reported the receipt of $16,100 for the first year of study. Similar appropriations have also been approved for each of the two subsequent years.

The new research work will continue an investigation of stabilization pond loadings being conducted by Dr. Rolf T. Skrinde, A.M. ASCE, assistant sanitary engineer and co-investigator of the project, under a one-year grant from the university. Three small experimental ponds constructed at the Pullman sewage treatment plant will be used for both projects. The two projects will merge in June.

The specific aim of the investigation will be to determine the types of biological organisms that contribute to stabilization in anaerobic-aerobic lagoon systems at high loadings, and to relate them to the physical and chemical changes occurring in the stabilization process.

EXAM GEMS

by Reggie Strashn

R. ROBINSON ROWE, F. ASCE

EXAMGEM No. 9 asked two questions about a 300-ft box culvert laid on a 2 percent grade to carry 250 cfs. Each was fairly easy for examinees who recognized energy controls.

First, to determine culvert size, headwater stage was limited to 4 ft above backwater submerging the outfall. The best tool for this problem is the Iowa formula,

$$Q = \frac{A\sqrt{2gh}}{\sqrt{1.05 + 0.0045LR^{-1.25}}} \quad . \; . \; . \; (1)$$

in which $Q = 250$, $g = 32.17$, $h = 4$, $L = 300$, and A and R are the area and hydraulic radius of the box section.

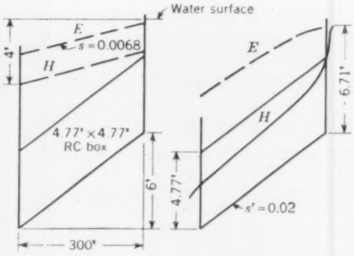
Handicapped by a ban on nomographs, the task is cut-and-try, for which it is convenient and permissible to adopt a square section, so that $A = b^2$ and $R = \frac{1}{4}b$. The equation then reduces to

$$b^{5.25} - 255\,b^{1.25} = 1845 \quad . \; . \; . \; . \; . \; . \; . \; (2)$$

which yields readily to a log-log rule to find $b = 4.77$ ft.

The examinee shouldn't use (1) without knowing that the binomial under the radical in the denominator is really a trinomial adding three head losses measured by the velocity head $h_v = v^2/2g$. The 1.05 represents h_v lost at the outfall and $0.05h_v$ lost at the entrance. The other term comes from the friction loss sL, so that

$$s = 0.0045h_vR^{-1.25} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; (3)$$



(a) (b)

Fig. 1. Vertical scale exaggerated to show energy (E) and hydraulic (H) grade lines for the same culvert, (a) with ends submerged and (b) with free outlet.

In this case, $v = 11.0$, $h_v = 1.88$, so that the 3 losses adding to the stipulated 4 ft are $h_e = 0.09$, $h_f = 2.03$ and $h_o = 1.88$. The commonest mistake was neglect of transition losses to make $h_f = 4$ and find $b = 4.2$ ft.

Fig. 1(*a*) shows the energy and hydraulic grade lines for the submerged condition for comparison with the second set-up, Fig. 1(*b*), a free-outlet condition for which the headwater elevation was to be computed.

The free-outlet stipulation led the uninitiated to attempt computation of a hydraulic profile upstream from the outfall. An assumption of either neutral or critical flow at that point led them up a cul-de-sac. On the other hand, their betters immediately recognized the real control at the entrance and proceeded to investigate two possibilities.

One possibility is a minimum-energy condition just outside the entrance, for which the critical depth

$$d_c = \sqrt[3]{Q^2b^2g} = 4.40 \text{ ft} \quad . \; . \; . \; . \; . \; (4)$$

The velocity head $h_v = \frac{1}{2}d_c = 2.20$ and the entrance loss is $0.05h_v = 0.11$, making the static headwater stage $4.40 + 2.20 + 0.11 = 6.71$ ft.

The other possibility is a choking of the entrance, so that $d = b = 4.77$, $v = 11$, $h_v = 1.88$, $h_e = 0.09$, making the headwater stage $4.77 + 1.88 + 0.09 = 6.74$ ft above the invert.

Either of these two nearly equal answers is acceptable, if properly qualified. The first can be realized with smooth inflow on a rising stage, but the entrance will be choked on a falling stage, or by rippling or surging of the flow, or by drift touching the culvert crown.

Altho many tripped in other pitfalls, the decisive factor was the ability gained by experience to identify energy controls of closed conduits. Gem quality was established by the problem's simplicity for the adept and complexity for the inept.

EXAMGEM No. 10

Not all states permit publication or even copying of examination problems, so no reference will be given for next gem. In fact, the data, as written down promptly by an examinee, have been doctored so its author won't be sure he is being quoted.

Figure 2 represents the neutral axes of four 24WF76 girders framing an elevator well EFGH to columns A, B, C and D, all supports being simple. If a vertical live load of 60 kips acts on the frame at G, compute the live reactions at the columns. If the live deflection at H is 0.10 in., what are the live deflections at E, F and G?

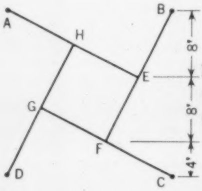


Fig. 2. The pinwheel frame with a new twist.

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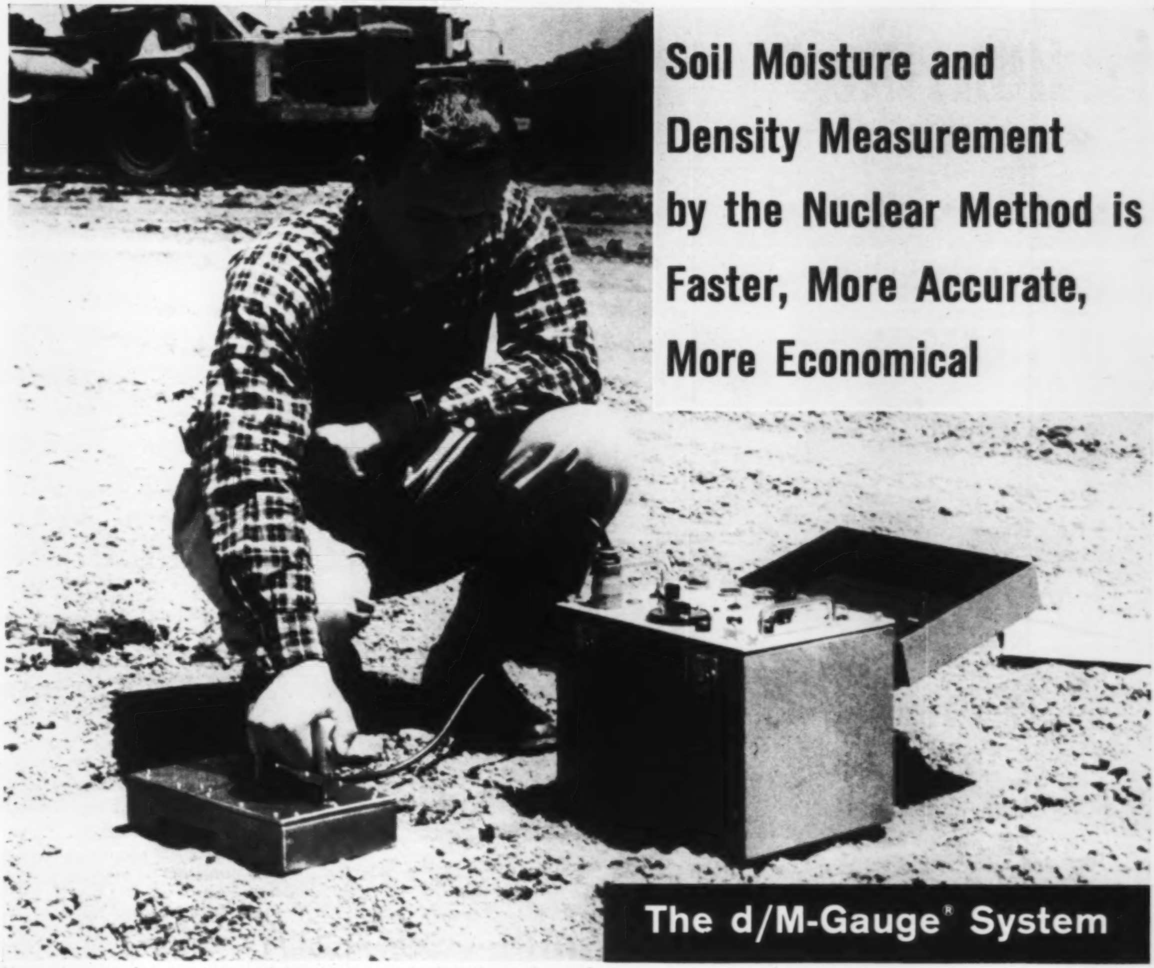

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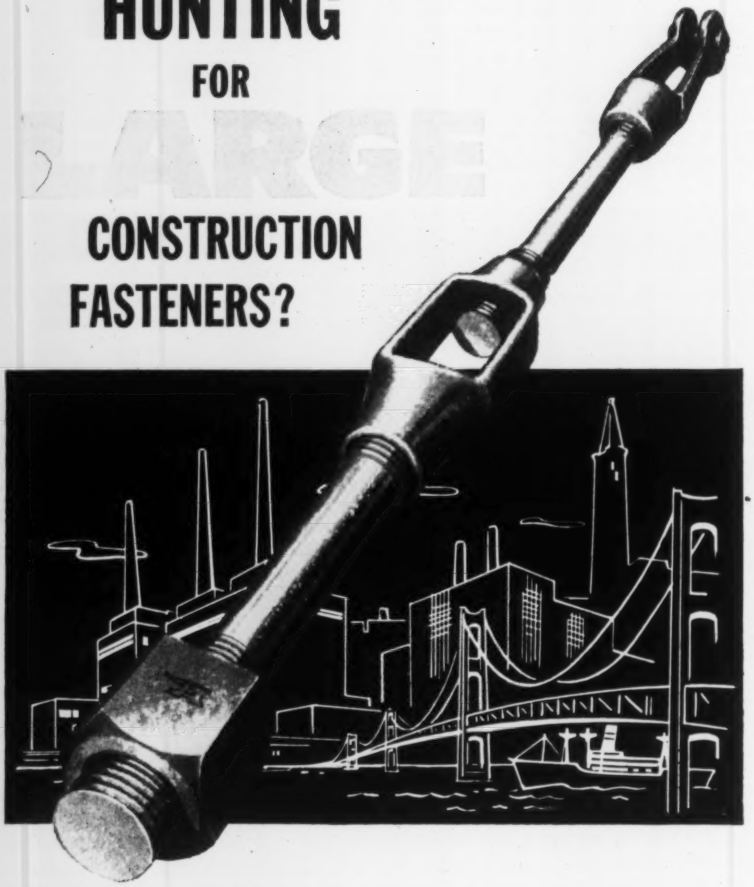

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Clark Alexander (A.M. '59), age 32, Mobile, Ala., civil engineer, died there on February 23. At the time of his death he was secretary-treasurer of the Haidt and Alexander Engineering Company which he formed in 1955 with Fred Haidt. He was educated at Auburn University and the University of Alabama.

Perry J. Freeman (M. '28; F. '59), age 78, principal materials engineer for the Tennessee Valley Authority from 1934 until his retirement in 1951, died in Tallahassee, Fla., recently. As head of the Inspection and Testing Branch, Mr. Freeman was responsible for materials on 20 dams and seven steam plants constructed by TVA during his term of office.

William E. Hamilton (M. '24, F. '59), age 75, since 1955 retired from the New York firm of Sanderson & Porter, died recently in Glen Ridge, N. J. From 1923 until 1942 when he became a partner in the firm he was manager of construction, working primarily on hydroelectric power plants, steam plants and transmission lines throughout the nation.

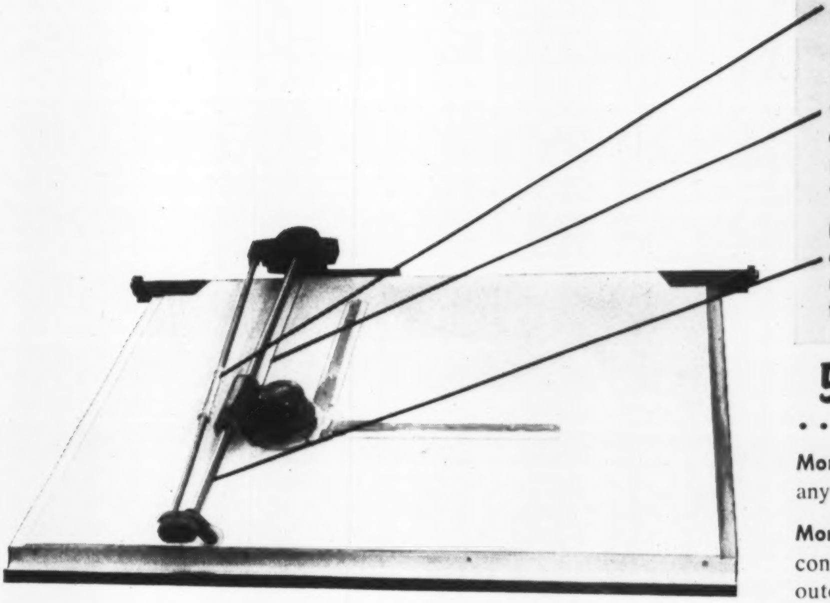
George Marshall Neel (M. '26; F. '59), age 79, New Mexico state engineer from 1924 to 1926 and again from 1930 to 1933, died recently in Santa Fe, N. Mex. Early in his professional life he made a drainage survey of the Rio Grande from White Rock Canyon to Elephant Butte Dam and was manager of the Associated General Contractors. In more recent years he maintained a consulting practice.

Stewart S. Neff (M. '34; F. '59), age 72, former engineer for the Knoxville (Tenn.) Board of Education, died recently in Oak Ridge, Tenn. Before retiring to Oak Ridge two years ago, Mr. Neff served with the Portland Cement Association at Knoxville for 15 years, was evaluation engineer with the Reconstruction Finance Corporation for two years, and for several years was engineer for Knoxville's post-World War II high school construction program. He had also been with the War Production Board at Knoxville.

Clayton W. Paige (M. '40; F. '59) age 57, since 1941 city engineer and director of public works for Burbank, Calif., died there recently. He had previously served as city engineer and superintendent of streets for Burbank and Alhambra. Mr. Paige was a commander in the Navy Seabees in World War II.

Jaroslav Joseph Polivka (M. '39; F. '59), age 73, noted for the design of un-

(Continued on page 118)



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Deceased

(Continued from page 116)

usual structures, such as the Czechoslovakia Pavilion at the Paris International Exposition in the 1930's and the Podolsko Bridge, the longest concrete arch span in Central Europe, died recently in Berkeley, Calif. Since coming to the United States from Czechoslovakia in 1938, he had been a research associate at the University of California, 1939-1945; a lecturer at Stanford University since 1951; and a consulting structural engineer at Berkeley. He was author of numerous works in the structural engineering field.

Ray Ranceri (M. '57; F. '59), age 51, a U. S. Public Health Service engineer prominent in Cincinnati, Ohio, engineering circles, died on February 25, in Baltimore, Md. After several years on public works projects in New York, he joined the Public Health Service at Cincinnati in 1940 to take part in Ohio River pollution studies. One of his outstanding contributions was designing and overseeing construction of the Robert A. Taft Sanitary Engineering Center where he was chief of experimental facilities at the time of his death.

George Peter Sangirardi (J.M. '57; A.M. '59), age 26, a private in the U. S. Army at Fort Myer, Arlington, Va., died recently. After graduating in June 1956 from the Manhattan College School of Engineering, Mr. Sangirardi worked briefly with Johnson Drake & Piper prior to entering the service. His home was in Valley Stream, N. Y.

Caleb M. Saville (M. '01; F. '59), age 91, manager and chief engineer of the Hartford (Conn.) Metropolitan District Commission for 16 years, died in Hartford on February 15. Mr. Saville's death ended a three-generation trio of Savilles belonging to ASCE, which included his son, Thorndike Saville, Sr., and his grandson, Thorndike Saville, Jr. The Saville Dam of the Barkhamsted Reservoir system was named after him in recognition of his work in changing the Hartford area water system from a one-city system to the present chain of reservoirs. One of the many honors accorded Mr. Saville occurred in 1914 when ASCE awarded him the Norman Medal for his paper on the hydrology of the Panama Canal, based on knowledge gained in the early 1900's when he was assistant division engineer in charge of the construction of the Gatun Locks.

Ralph Smillie (M. '24; F. '59), age 72, a leader in the field of tunnel design and construction, died on February 16 at Montclair, N. J. His achievements included the design of the Holland and Lincoln tunnels, the construction of the Brooklyn-Battery Tunnel and the Sumner Vehicular Tunnel under Boston Har-

(Continued on page 120)

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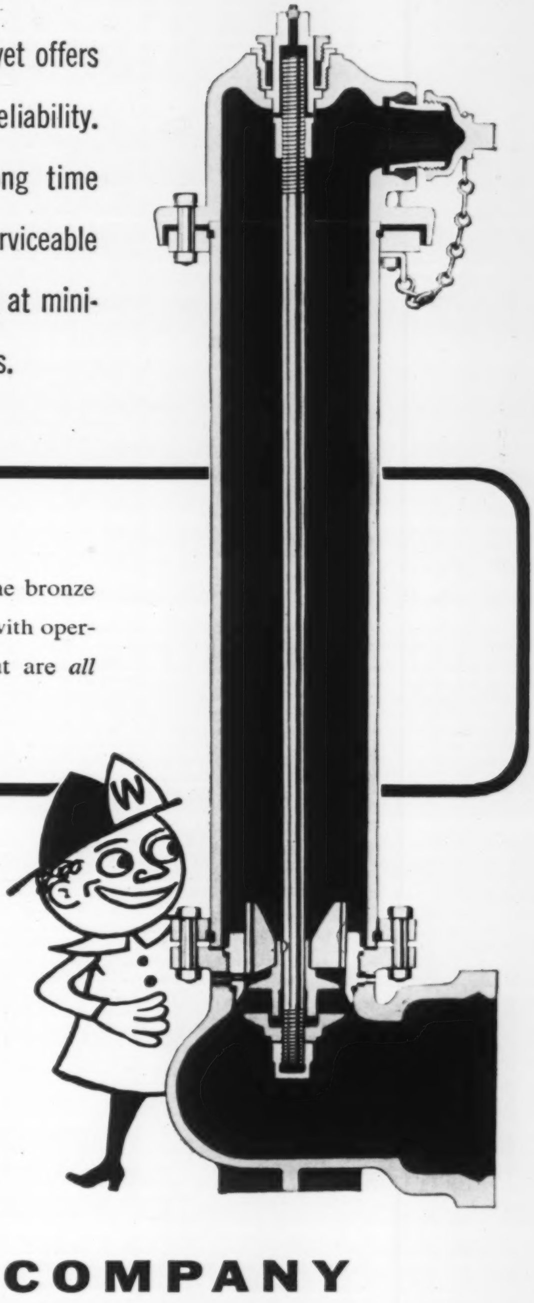

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Valve opens against water pressure, remains closed in case of accident. Head revolves 360°. Optional break-point flange and breakable stem coupling permit quick repair without excavating. Optional extension piece can be inserted without shutting off water. Available with bell, mechanical joint or flange pipe connections; conventional or "O" ring packings.

Conform to latest AWWA specifications

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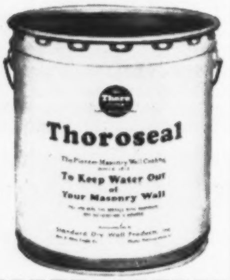
Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers also of Mathews Modernized Hydrants, Mathews Flange Barrel Hydrants,
R. D. Wood Gate Valves, and "Sand-Spun" Pipe (centrifugally cast in sand molds)

CONCRETE IS NOT FOREVER

It pays an engineer to remind himself that concrete starts to break down the instant the forms are off . . . in major or minor degree depending on weather, corrosion or moisture pressure. When conditions are severe, no reminder is necessary, but somewhat more obscure is the need for high quality protective materials. Inferior coatings always cost more eventually. Since 1912, Standard Dry Wall, Inc. has been in no other business than the protection of masonry, and its products are leaders in the field. Thoroseal, for example, may be easily applied with our money-saving, long-handled brush, and will impart both a waterproof and decorative surface in gray, white or color. Write for our free specification folder on all Thoro System products.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To Keep Water Out of Your Masonry Wall
Standard Dry Wall Products, Inc.

Please send new 20-page specification guide describing all products and uses.

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Address____________________

Standard | Dry Wall Products, Inc.

Box X-13 New Eagle, Pa.

Plants at New Eagle, Pennsylvania and Centerville, Indiana

Deceased

(Continued from page 118)

bor. He also worked on a tunnel under the Fraser River at Vancouver. Since 1950 he had been a partner in the New York firm of Smillie & Griffin.

Howard Carl Steavenson (A.M. '53; M. '59), age 53, general contractor, of Tyler, Tex., died there recently. Mr. Steavenson was general superintendent in charge of construction of the Waco, (Tex.) plant of the General Tire and Rubber Company for Brown & Root, Inc., during the 1940's. Later he was general superintendent for H. E. White, of Tyler.

S. H. Taylor (M. '48; F. '59), age 58, from 1938 to 1953 Camden (N. J.) county engineer, died on January 25, in Philadelphia, Pa. Before resigning as county engineer to devote his time to the firm of Sherman, Taylor and Sleeper, in which he was a partner, Mr. Taylor helped design the western end of the Black Horse Pike, and part of the New Jersey Turnpike.

John R. Thatcher (A.M. '35; M. '59), age 58, a 32-year veteran with the Army Corps of Engineers, died in Walla Walla, Wash., on March 1. He joined the Walla Walla District Office in 1953, and had charge of the Program Development Branch, recently acting as assistant to the chief of the Engineering Division.

Charles Edward Via, Jr. (A.M. '53; M. '59), age 42, for ten years owner and operator of the Quantity Estimating Service and the general contracting firm of Charles E. Via, Roanoke, Va., died there on February 6. Mr. Via specialized in remodeling and repairing industrial buildings, stores and houses requiring structural changes. During World War II he served with the Navy Civil Engineer Corps in Okinawa as public works officer. Mr. Via was keenly interested in the activities of the Virginia Section, serving in 1958 as president and more recently as chairman of the Section's UEC campaign.

Joseph Ray Williard (J.M. '58; A.M. '59), age 23, of the Pennsylvania Department of Highways at Rossiter, Pa., died recently in an automobile accident. Mr. Williard graduated from Pennsylvania State University in 1958 with a B.S. in civil engineering.

Joseph J. Yates (M. '18; F. '59), age 87, retired railroad executive, died March 6 in North Plainfield, N. J. He started his railroad career with the Pennsylvania Railroad in 1894, after graduation from Rutgers University, and later served as chief bridge engineer for the Jersey Central Railroad. Mr. Yates retired from this latter position in 1947.

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TAMPA • ST. PETERSBURG
DECATUR, GA.

Laying heavy-duty Texaco Asphaltic Concrete pavement on 13 miles of U. S. Route 19, used by traffic to and from Florida's Sunshine Skyway Bridge.

Florida converts inadequate road into a dual Asphalt highway

When Florida built the new Sunshine Skyway Bridge over Tampa Bay, U. S. Route 19 in Pinellas County could not cope with traffic to and from the bridge. The State remedied this by converting the old 24-foot road into a modern, divided Asphalt highway.

A new 24-foot lane was constructed for northbound traffic. Its heavy-duty surface of hot-mix Texaco Asphaltic Concrete was laid on an 8½-inch limerock foundation, over a 12-inch stabilized subgrade.

Hot-mix Texaco Asphaltic Concrete also was used to resurface the existing road, which now serves southbound traffic.

This economical method of using heavy-duty Texaco Asphalt paving to convert existing, inadequate roads into up-to-date, divided highways offers substantial savings in the construction of many sections of the Interstate Highway System.

Whether you are building a highway in Florida, a farm-to-market road in Wisconsin, an airport in Texas or a municipal expressway in Rhode Island, Texaco Asphalt products are conveniently available at strategically located refineries and terminals. For assistance with an Asphalt paving or maintenance problem, get in touch with our nearest office listed below. Our 55 years of Asphalt experience is at your service.

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Please send me your two brochures containing helpful information on heavy-duty, intermediate and low-cost types of asphalt construction for highways, streets, airports, etc.

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New in education

Columbia offers new degree . . .

Four National Defense Graduate Fellowships are available for 1960-1961 for study of "Dynamic Structural Design" at *Columbia University's Department of Civil Engineering and Engineering Mechanics.* As provided by the National Defense Education Act of 1958 first-year graduate students will receive a stipend of $2,000, plus $400 for each dependent. The University is also offering a new degree of Nuclear Engineering beginning next September. The new degree requires 30 points of courses beyond the M.S. degree—60 points of courses beyond a B.S. degree if the candidate did not previously receive an M.S.—and does not require a thesis if the student submitted a thesis for a Master's degree. Comprehensive examinations are required, however.

River pollution study . . .

Nature's own method of fighting river pollution will be the objective of a three-year investigation by the *University of Michigan School of Public Health.* Under a $52,669 grant by the U. S. Public Health Service covering the period, Associate Professor John J. Gannon, A.M. ASCE, will direct a study of two Michigan rivers. Researchers will choose one river which carries domestic organic waste, and another with industrial organic waste. From their findings, they hope to aid the natural self-purification process.

New data processing center . . .

Representatives of Southern colleges, universities, research organizations and industrial organizations attended the dedication of the largest campus-based computer center in the South on January 7, as the *Texas Agricultural and Mechanical College System* unveiled a $3.5 million Data Processing Center on the College's campus. The center houses an IBM-704 high-speed electronic data processing machine, an IBM-605 medium-speed data processer, and an IBM-604 electronic computer.

Opportunities for graduate study . . .

Excellent opportunities for graduate study exist in civil engineering at the *Carnegie Institute of Technology*, Pittsburgh, Pa. Fellowship, assistantships and scholarships are available in all areas of civil engineering, but particularly in hydraulic engineering and fluid mechanics, foundation engineering and soil mechanics, structural engineering and solid mechanics, and materials. Included are six new special three-year Fellowships, which are supported by the National Defense Education Act of 1958, and pay stipends of $2,000 for the first year, $2,200 for the second year, and $2,400 for the third year (plus $400 per year per dependent); and a Fellowship-Loan Program—under funds made available by the Ford Foundation and paying up to $6,000 per student per year—for civil engineering Pre-Doctoral candidates preparing for academic careers. Special grants for Fellowships of $9,600 per student (plus $400 per year per dependent) are part of the Institute's three-year doctoral program in the sciences of materials. For further information write to Dr. Thomas E. Stelson, Head, Department of Civil Engineering, Carnegie Institute of Technology, Pittsburgh 13, Pa.

NDEA scholarships . . .

Awards made in all fields of engineering by the Department of Health, Education and Welfare under the National Defense Education Act for the academic year beginning in September, 1960, represents an increase from only 81 out of 1,000 scholarships to 144 out of 750. Each of the scholarships covers a three year period with stipends to the student of $2,000, $2,200 and $2,400 for the three years plus $400 per year per dependent. To date the following institutions have qualified for the NDEA scholarships:

University of Arizona	4
Carnegie Institute of Technology	6
Utah State University	2
North Carolina State College	3
Colorado State University	2
University of Washington	2
Virginia Polytechnic Institute	3
University of Pennsylvania	6
University of California	2
Columbia University	4
Massachusetts Institute of Technology	4
A and M. College of Texas	4

Fenn College expansion program . . .

Fenn College in the midst of a development program, had open house recently to display its attractive new engineering and science building, Stilwell Hall. Fenn's expansion program, which includes construction of eight new buildings, three of them skyscraper dormitories, is geared to handle 10,000 students within the next decade, double its present enrollment. These hopeful and imaginative plans are attributed largely to G. Brooks Earnest, Fenn's energetic, far-sighted president and former Director and Vice President of ASCE.

Engineering schools combine . . .

The Schools of Civil and Mechanical Engineering at the *University of Pennsylvania*, which have long been separate units, will be combined to form the Towne School of Civil and Mechanical Engineering, in honor of the University's benefactor, the late John Henry Towne. The action is being taken in recognition of the fact that a number of subjects are of common interest to students in both schools. It is expected that the Towne School will be completed in time for the 1960-1961 term.

Newark College celebrates 75 years . . .

New Jersey's Governor Robert B. Meyner cited *Newark College of Engineering* as "one of the State's great educational institutions," at the College's 75th anniversary Founders Day Dinner, which opened a four-month celebration of the birth date of the Newark Technical School, predecessor of today's NCE, on February 9, 1885. One of the few higher educational institutions in the U. S. supported by both a city and a state, Newark College of Engineering throughout its 75-year history "has demonstrated constant responsiveness to the needs of the community to which it belongs." In keeping with this policy, a broad program to attract recent engineering graduates to the teaching profession by offering fellowships which combine teaching and research along with advanced study has been instituted. The fellowships are based on a 10-month year with summer employment available either at the College or in the highly industrialized northern New Jersey area.

At the University of Illinois . . .

Freshmen entering the *College of Engineering at the University of Illinois*, beginning with the fall semester of 1963 must meet new entrance requirements. The greatest revision is the requirement for two years of foreign language and added emphasis on science courses such as physics, chemistry and biology, and not including general science. The step is taken in the belief that the increasing responsibilities of the engineer in society require a broad understanding of the social sciences and the humanities, while today's technical world requires of an engineer a stronger background in mathematics and science than ever before.

Future Illinois license plates will have no more than six identification characters if recommendations based on a two-year study made at the *University of Illinois* are adopted. Research was carried on under Prof. John W. Baerwald, A.M. ASCE, Delbert F. Karmeier and C. Gordon Herrington, M. ASCE—the latter two at the time were graduate students. Their research showed that for fast, accurate perception no identification should have more than six characters, and that if letters and numbers are used, letters should be grouped together at the beginning or the end.

Construction costs go down when you design for . . . REINFORCED CONCRETE

Photograph Courtesy of Texas Highway Department

When compared with other construction materials, the cost trend of reinforced concrete bridges, overpasses, and other highway structures is usually less!

They are lower in first cost because projects always start on time—finish on schedule. There are no expensive delays due to material shortages or necessary field changes. Materials and labor are readily available from local sources.

They are lower in aftercosts, too! Reinforced concrete structures are weather resistant—require less maintenance, and are resistant to wind, shock, and quake.

On your next project, design for reinforced concrete and compare its many cost-saving advantages.

Concrete Reinforcing Steel Institute
38 South Dearborn Street
Chicago 3, Illinois

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New Publications

Skid prevention . . . . All the factors involved in preventing skidding from proper design of road, car, and tire to proper driving practices are studied in the "Proceedings of the First International Skid Prevention Conference," which have been made available by the Virginia Council of Highway Investigation and Research. The conference was held at the University of Virginia in September 1958. The proceedings include 59 papers, with their discussions, and reports of five conference subcommittees setting forth findings and recommendations in many of the areas involved. Copies, priced at $10.00 each, may be obtained from the Virginia Council of Highway Investigation and Research, Box 3817, University Station, Charlottesville, Va.

Steel . . . . A graphic facts book on the iron and steel industry, with special reference to 1959, has been issued by the American Iron and Steel Institute. The 68-page publication, entitled "Charting Steel's Progress," is the sixth edition of an annual series started in 1954. For maximum interest, data are often given against background statistics from other industries and other countries. The booklet sells for 50 cents a copy and may be obtained from the American Iron and Steel Institute, 150 East 42nd Street, New York 17, N. Y.

Construction contract bonds . . . . The nature and function of construction contract bonds—bid, performance, and payment, and the advantages of the bonded contract to owner, architect, engineer, contractor, and subcontractor—are discussed in a 44-page booklet recently published by the Surety Association of America. Under the title, "Bonds of Suretyship," the booklet reproduces in convenient form the three sections on surety bonds in the recently revised edition of the American Institute of Architects' "Handbook of Architectural Practices." Members may obtain single copies without charge from the Educational Department of the Surety Association of America, 60 John Street, New York 38, N. Y.

Hydraulic research . . . . Issuance of "Hydraulic Research in the United States, 1959," is announced by the National Bureau of Standards. The publication, the latest in an annual series dating back to 1951, includes Canadian research, too. Helen K. Middleton is editor of the volume, which may be ordered from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. The price is $1.25 a copy.

Industrial waste . . . . Municipal officials who are considering the adoption or revision of regulations and surcharges for the acceptance of industrial-waste discharges will find a recent publication of the American Public Works Association a valuable guide to the subject. The 20-page report, entitled "Guide Lines for Drafting a Municipal Ordinance on Industrial-Waste Regulations and Surcharges," was prepared by Edward J. Cleary, F. ASCE, executive director and chief engineer of the Ohio River Valley Sanitation Commission. It is available from the American Public Works Association, 1313 East 60th Street, Chicago 37, Ill. The price is $3.00 a copy.

Construction materials . . . . The problem of chert as a reactive ingredient in concrete aggregate is discussed in Special Report 55 of the California Division of Mines. The report written by Harold B. Goldman, staff geologist, and entitled "Franciscan Chert in California Concrete Aggregates" describes the nature and determination of the chemical and physical properties of the chert that affect its use in portland cement. Copies, priced at 50 cents apiece, may be obtained from the California Division of Mines, Ferry Building, San Francisco 11, Calif.

Soil study . . . . Vaughn E. Hansen, F. ASCE, director of the Engineering Experiment Station at Utah State University, is co-author (with Karl Harris) of a recent bulletin entitled "Relative Productive Value of Land." The three basic factors considered in this study of the productive capacity of land are water, climate, and soil. Inquiries about the publication identified as Bulletin No. 6 should be addressed to the Engineering Experiment Station, Utah State University, Logan, Utah.

Soil mechanics . . . . A second edition of "Laboratory Manual in Soil Mechanics" by Raymond F. Dawson, F. ASCE, professor of civil engineering at the University of Texas, is now available from the Pitman Publishing Corporation (2 West 45th Street, New York, N. Y.), at $4.00 a copy. The notes were originally prepared for use in the author's laboratory classes in soil mechanics. While many of the tests follow the standard methods prescribed by the American Society for Testing Materials and the American Association of State Highway Officials, it was believed that these methods were not sufficiently detailed to permit the student to make laboratory experiments without additional instruction. Many of the U.S. tests included originated in the laboratories of the Bureau of Public Roads, Harvard University, and the Massachusetts Institute of Technology.

Sewage disposal, California . . . . About two-thirds of California's sewage and industrial waste is discharged into the state's estuarine and coastal waters. Since these areas are in ever-increasing demand for recreational use, the State Water Pollution Control Board has been conducting a series of research projects to determine the technical and economic feasibility of marine disposal. A five-year oceanographic survey of the Continental Shelf area of Southern California has now been completed for the Board by the Allan Hancock Foundation of the University of Southern California. The group of reports constituting the survey has been assembled by the State Water Pollution Control Board as Publication No. 20. Copies may be purchased, at $4.00 apiece, from the State Printing Division, Documents Section, Sacramento 14, Calif. Residents of California must add 16 cents for the state sales tax.

HERE'S SPRAGUE & HENWOOD'S TIME & MONEY SAVER

EXAMPLE:

Have you ever found, after a concrete floor was finished that sleeves had been set in the wrong place, or that they had moved during the pouring? Have you ever found that you needed additional holes for which no sleeves had been set? If you have then you know there should be an easier way to spot and make these holes—**HERE IT IS:** Sleeves could be eliminated, and floors poured solid. Then the required holes can be spotted accurately, and drilled cleanly . . . smoothly . . . quickly and in the required diameter with Sprague & Henwood Masonry diamond bits. Re-inforced concrete presents no problem.

Other ways to save time and money are to use Sprague & Henwood Masonry diamond bits in drilling holes in glass . . . ceramic tile . . . brick . . . stone . . . concrete . . . asphaltic concrete, plus many other hard or brittle materials. Sprague & Henwood manufactures three types of Masonry diamond bits: Resettable—Throw-Away—Impregnated.

Write today for more information on how you can save money . . . save time . . . and in the final result make more money for yourself or your firm.

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Look for our emblem... It's your Seal of Quality

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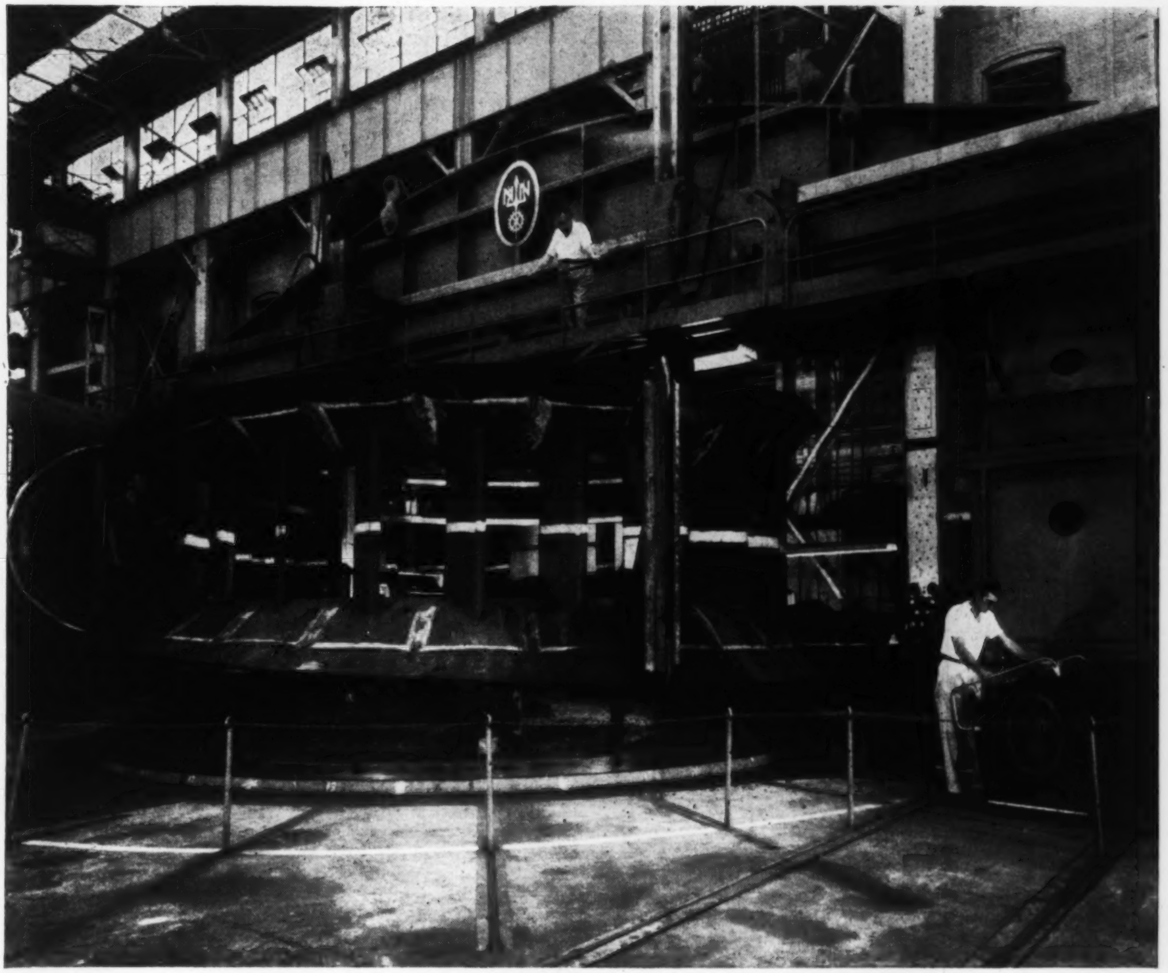

42 ft. boring mill-rough cuts a stay ring for one of the world's most powerful hydraulic turbines.

Newport News builds six king-size turbines for Niagara Power Project

These skilled Newport News machinists are milling a stay ring for one of six 200,000 hp. Francis-type hydraulic turbines. Before they're finished, they'll turn out five more turbines—the world's most powerful—for the Lewiston Power Plant of the Niagara Project.

Newport News has not only the men, but the facilities to take a job like this in its stride... your job, too. For example, the 42 ft. boring mill pictured above was designed and built at Newport News.

The large engineering and technical staffs, acres of iron, brass and steel foundries, five huge machine shops, and additional specialized equipment make Newport News a leader in the production of hydraulic turbines, valves, gates, penstocks, and other water power equipment you need.

Consult Newport News engineers on preliminary design recommendations at no obligation.

Engineers . . . Desirable positions available at Newport News for Designers and Engineers in many categories. Address inquiries to Employment Manager.

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RECENT BOOKS

(added to the Engineering Societies Library)

An Introduction to the Dynamics of Framed Structures

Using two mathematical tools, matrices and orthogonal functions, the author presents the analytical aspects of dynamic disturbances in structures. Particular applications dealt with include stresses and strains in structures during and after earthquakes and atomic blasts, action of moving loads such as highway and railroad bridge loadings, deflections and bonding movements, and velocities and shear forces in structures acted upon by dynamic disturbances. (By Grover L. Rogers. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1959. 355 pp., bound. $10.25.)

Advanced Engineering Mathematics

Second Edition

An introduction to those branches of mathematics relevant to the engineer and the physicist, this edition contains a new chapter on determinants and matrices, and one on finite differences which includes the theory of orthogonal polynomials and the techniques of numerical analysis. Ordinary, linear, and simultaneous linear differential equations are covered thoroughly, and the section on partial differential equations includes solution by Laplace transform. Detailed treatment also is accorded the Fourier series, Bessel functions, Legendre polynomials, vector analysis, conformal mapping and the theory of residues. (By C. R. Wylie, Jr. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1960. 696 pp., bound. $9.00.)

Allgemeines Iterationsverfahren Fur Verschiebliche Stabwerke

Deals with general iteration methods for structures, composed of members having any type of slope under any load, temperature effect, and column settlement. The book is meant for practical engineers and does not require much background knowledge on frame statics or special mathematics, the author having tried to render the development and application of equations very clear. The work includes a number of fully solved examples. (By Reinhold Glatz. Verlag von Wilhelm Ernst & Sohn, Berlin, Germany, 1958. 117 pp., bound. 24 DM.)

Analysis of Statically Indeterminate Structures

Fourth Edition

Efforts made since 1943 to simplify and render more understandable the methods used in structural analysis are embodied in this fourth edition of a comprehensive text designed to provide a firm grounding in the basic principles and concepts of action of structural members subject to load. Examples and practical problems illustrate the use of an analytical approach and induce development of problem-solving procedures. (By Clifford D. Williams. International Textbook Company, Scranton, Pa., 1959. 360 pp., bound. $9.25.)

Beaches and Coasts

The main factors on which the character of a beach depends include beach material, waves, tides, and winds; the inter-relationships between these elements are the subject of this book. The movement and grading of material and its effect on the changing profile of the beach is the main theme, and wave actions, both constructive and destructive, are covered thoroughly. Coastal types are classified and described and historical data on coastal change is given. (By Cuchlaine A. M. King. St. Martin's Press, 103 Park Avenue, New York 17, N. Y., 1959. 403 pp., bound. $14.50.)

Plumbing

Third Edition

Many important modern developments are included in this third edition, such as recent applications of hydraulics and pneumatics to the design of traps, drainage and vent pipes, and innovations in hot water supply and storage tanks. Modern plumbing practice is examined systematically, from the basic hydraulics, mechanics and pneumatics to systems design, materials, equipment and fittings, and installation and maintenance. The National Plumbing Code is followed closely, and extensive tables and lists of weights, dimensions and standard specifications are included. There are useful practical illustrations and a glossary of technical terms. (By Harold E. Babbitt. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1960. 649 pp., bound. $13.50.)

Nature and Properties of Engineering Materials

Here is information on basic materials for specific engineering applications. A consideration of the basic concepts of interatomic and intermolecular forces and their relationship to the structural characteristics of crystalline and amorphous materials forms the basis of the discussion of the phenomena of diffusion, crystallization, phase transformation and phase equilibria. Then follows a more specific development of the characteristic physical properties of metals and ceramics, electrical and magnetic properties of materials, corrosion, friction and lubrication, concrete, and protective coatings. (By Zbigniew D. Jastrzebski. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1959. 571 pp., bound. $11.00.)

Route Surveys and Design

Fourth Edition

Necessitated by revolutionary developments in photogrammetry and electronics since 1953, this fourth edition of "Route Location and Surveying" indicates the widened conception of highway construction in its title "Route Surveys and Design." Substantial revisions and additional material, as in aerial survey methods, new treatments of concentric, compound and parabolic curves, and new tables calculated on desk and electronic calculators, are balanced by elimination of obsolete material to retain the useful compactness and size of this text. (By Thomas F. Hickerson. McGraw-Hill Book Company, 330 West 42nd Street, New York 36, N. Y., 1959. 568 pp., bound. $8.50.)

Library Services

Engineering Societies Library books, except bibliographies, handbooks, and other reference publications, may be borrowed by mail by (the Society's initials, eg. ASCE) members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any items in ~~its~~ collection. Address inquiries ~~to R.~~ H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

Symposium on Effect of Water on Bituminous Paving Mixtures

The six papers contained in this volume discuss the factors which play a significant part in the behavior of bituminous paving mixtures when exposed to the stripping action of water. The studies are based on field observations and laboratory studies. (Published as Special Technical Publication No. 240, by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, 1959. 96 pp., bound. $2.75.)

Systems of Units: National and International Aspects

International exchange of technical information would be greatly promoted by a more nearly universal system of units. To focus attention on the growing problems of unit usages, this symposium presents authoritative discussions from the U.S. and abroad dealing with English versus metric units and the absolute versus the gravitational (technical) system. Treatment of the mks-a system also is included. (Edited by Carl F. Kayan. American Association for the Advancement of Science, 1515 Massachusetts Avenue, N.W., Washington 5, D. C., 1959. 297 pp., bound. $6.75.)

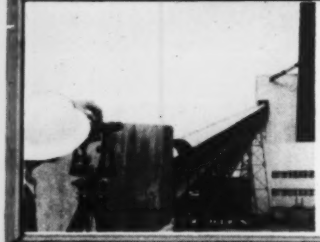
The Theory of Thin Shells

This translation from the Russian presents an analysis of stress and deformations in shells treated as a linear problem with displacements assumed to be small in comparison with the thickness of the shell and strains not to exceed the limit of proportionality. The four chapters treat the general theory of thin shells, the membrane theory, analysis of cylindrical shells, and shells of revolution, giving a unified point of view based on a wide utilipation of complex transformations. (By V. V. Novophilov. P. Noordhoff Ltd., Groningen, The Netherlands, 1959. 376 pp., paper. $9.50.)

A Treatise on the Law of Surveying and Boundaries

Third Edition

While much of the information on surveying and boundaries in the previous edition of Clark is still applicable, changes and additional statutes and court decisions have made a new edition necessary. The chapters on public lands surveys, the restoration of lost or obliterated corners, and government rules for lots and subdivisions have been considerably revised. The tracking of surveys; reading instruments of conveyance; boundaries and rights concerned with highways, lakes, streams, and rivers; pertinent state laws and court decisions, and the Canadian rectangular system of determination are other important topics covered. Footnotes referring to court decisions have been practically eliminated from this edition to save space. (By Frank Emerson Clark. The Third Edition by John S. Grimes. The Bobbs-Merrill Company, Inc., 1720 East 38th Street, Indianapolis 6, Ind., 1959. 1031 pp., bound. $12.50.)



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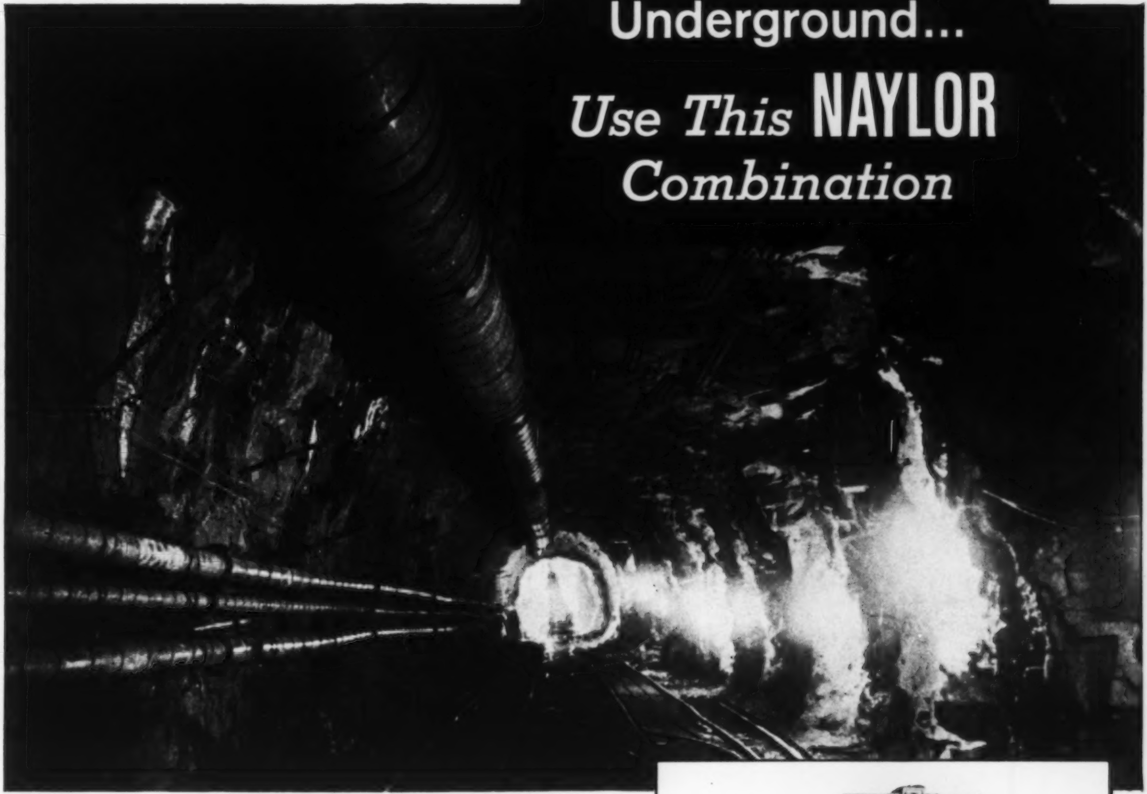
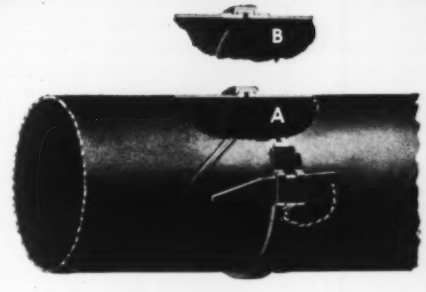
Use This NAYLOR *Combination*





The NAYLOR Low-Pressure Wedgelock coupling for ventilating service can be furnished for pipe with (A) accurately-sized shoulder ends, or (B) with grooved ends. A hammer is the only tool needed to connect or disconnect this coupling.

When you need lines to bring in fresh air and to exhaust gases and fumes in underground construction, there's no better pipe line combination than NAYLOR Spiralweld pipe and NAYLOR Wedgelock couplings.

The distinctive lockseam-spiralweld structure creates a light-wall pipe with extra collapse strength and safety factors for push-pull ventilation. The Wedgelock coupling speeds installation and makes it possible to couple joints with only one side of the pipe in the open. Lines hug the wall and can be extended quickly as work progresses.

For air, water and ventilating service, it will pay you to get the story on this NAYLOR pipe line combination. Ask for Bulletin No. 59.

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OZALID NEWSLETTER

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How to break the halftone costs barrier

Some of the sharper repro men looking to cut the high cost of using halftones in quantity have come up with this little timesaver that goes for pennies per halftone. Here was the problem: 200 rush copies of 16 technical photographs were needed for a service manual . . . a total of 3200 prints. This job would usually run about $2,000 and take ten days . . . that was too long and cost too much.

A bright lad thought about their Ozalid whiteprinting equipment and worked out this procedure: First an 8″ x 10″ screened film positive was made by projection from a 4″ x 5″ negative, emulsion away from emulsion. This insured proper orientation of the print in the final stage.

Next, the film positive and Ozalid black-line plastic-coated paper (105SZ) were processed in an Ozalid Printmaster 810 at a rate of 12 feet per minute. The 42-inch width of this machine permitted two operators to work simultaneously, cutting total production time virtually in half! The choice of Ozalid paper Type 105SZ was an excellent one. It gave crisp, black-line images of great density due to the paper's plastic coating. The entire project took just under a fast six hours instead of the usual ten days, and cost about $100.

Total savings: $1900 and 9½ days of production time. Pretty smart, we think. By the way, we've got sample packages available for the asking that might very well give you the same dramatic results. Why not write us at Ozalid, Box QQ4, Johnson City, New York. We'll be glad to help.

Looking for a fast case of the blues?

The happy kind, we mean. The clean, rich, decisive blue image that Ozalid's new Super-Speed Blue-Line (200SS) gives. And when we say fast, that's exactly what we mean. *Poor originals are copied up to ten feet per minute faster than with regular copy papers.*

This is the first Ozalid copy paper specifically designed for copying semi-opaque originals at higher speeds . . . at no sacrifice of line density in any sense!

But what does all this mean in practical benefits, other than increased production at no loss in quality?

Well, for one thing, it means that you can now do a fine job on semi-opaque material, such as one-sided letters, documents and bulletins, at the lowest cost of any copying process . . . even if they're printed on bond papers!

Another benefit is the clean, readable copies you can now produce from soiled, yellowed documents and low-translucency materials much faster than ever before.

Is that all? Not by a long shot. 200SS actually turns low-powered ultraviolet machines into pretty fast units. And the faster printing speeds mean faster return of the original after each cycle.

Why not try this superb, high-density blue-line paper today? It really makes sense. Just call your local Ozalid representative for a demonstration.

***Ozalid**—Division of General Aniline & Film Corp. • In Canada: Hughes-Owens Co., Ltd., Montreal*

LARGEST REINFORCING BAR ORDER IN BETHLEHEM'S HISTORY—Typical scene during the construction of the 4-mile long twin conduits at the gigantic Niagara Power Project. When completed, the project will add 1,950,000 kw to the power facilities of New York State. Some 60,000 tons of Bethlehem reinforcing bars were required for the project, being built under the direction of the Power Authority of the State of New York. Contractors on this portion of the project: Balf-Savin-Winkelman, and Gull-De Felice.

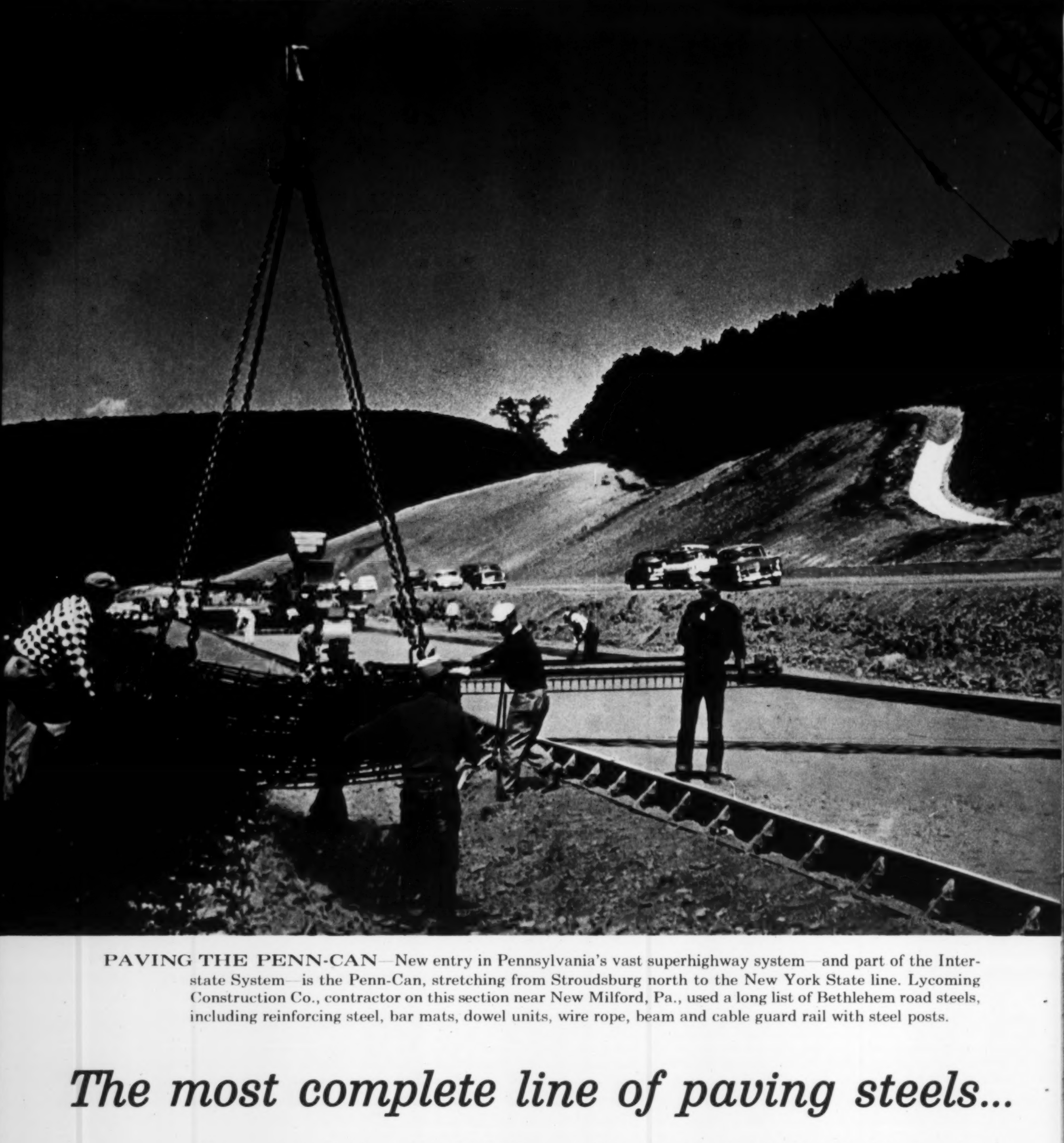
Bethlehem Steel Products for Concreting

Reinforcing Bars, plain and fabricated . . . Bar Supports . . . Nails and Tie Wire for formwork . . . Bars and Strand for prestressed concrete . . . Tie-Rods . . . Standard and Special Fasteners.

Bethlehem reinforcing bars come in a complete range of sizes, including the giants, 14S and 18S. They're all made of new-billet steel. This is your guarantee of composition, mechanical, and physical properties. When bundles of Bethlehem bars arrive at the job, certified mill test reports, matched with heat numbers, can identify your bars with the specific heat tapped from our open-hearth furnaces.

Steel

BETHLEHEM STEEL



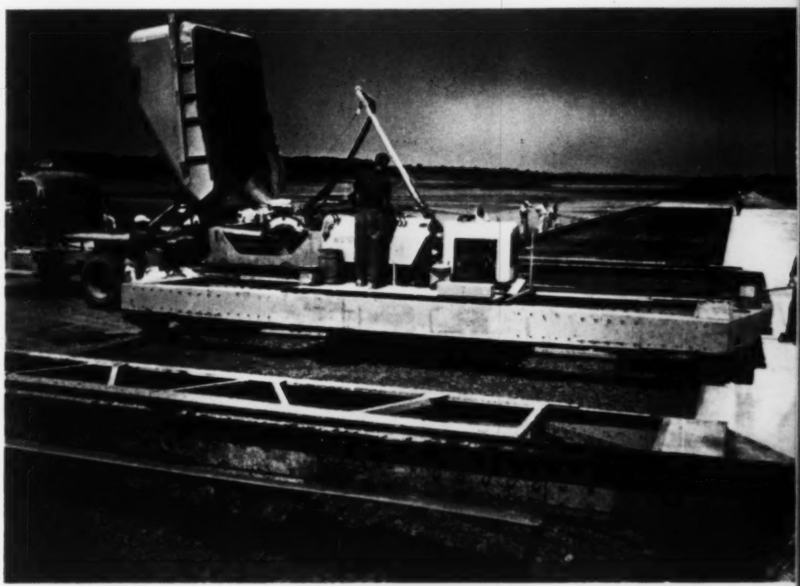
PAVING THE PENN-CAN—New entry in Pennsylvania's vast superhighway system—and part of the Interstate System—is the Penn-Can, stretching from Stroudsburg north to the New York State line. Lycoming Construction Co., contractor on this section near New Milford, Pa., used a long list of Bethlehem road steels, including reinforcing steel, bar mats, dowel units, wire rope, beam and cable guard rail with steel posts.

The most complete line of paving steels...

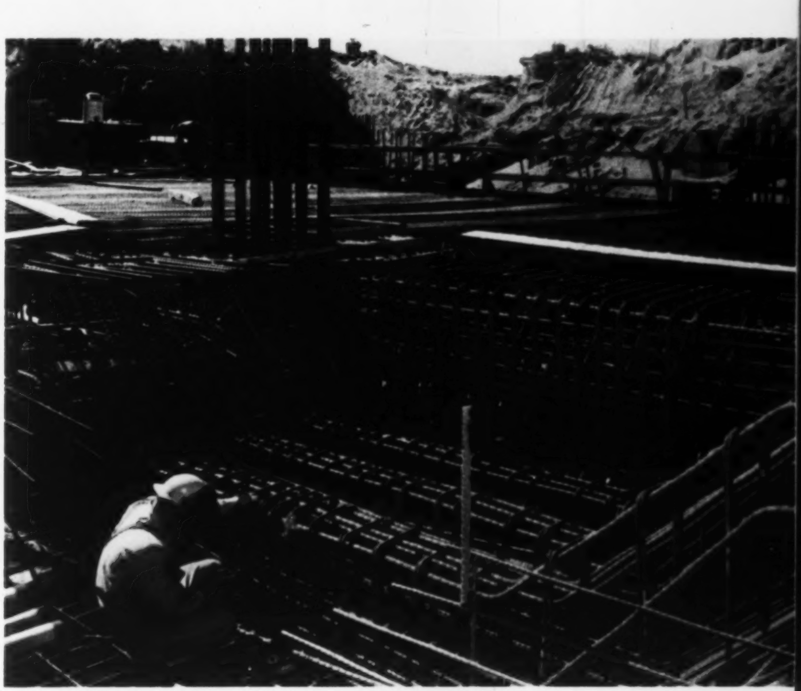
When you are in the market for highway steels, remember that besides the list of paving steels at the right, Bethlehem supplies steels for right-of-way work: hollow and solid drill steel, special analysis steels for construction equipment, culvert sheets, wire rope, etc. Bethlehem steel products for the finished highway include fabricated plates and shapes for bridges and underpasses, guard rails and posts, bridge rails, fence, and fence posts.

We've had years of experience in supplying steel for highways. We understand the road builder's problems. Our people are more than glad to talk over your job with you at any time.

BETHLEHEM STEEL



JET-AGE AIRPORT—At Dulles International Airport, Chantilly, Va., runways 10,000 to 11,500 ft long, 150 ft wide, and 12 to 15 in. thick are laid to accommodate jet aircraft. Like any heavy-duty roadbed, the concrete is interlaced with reinforcing steel for strength and with dowel units for expansion, contraction, and weight transferral between slabs. Contractor: C. J. Langenfelder & Son, Inc.

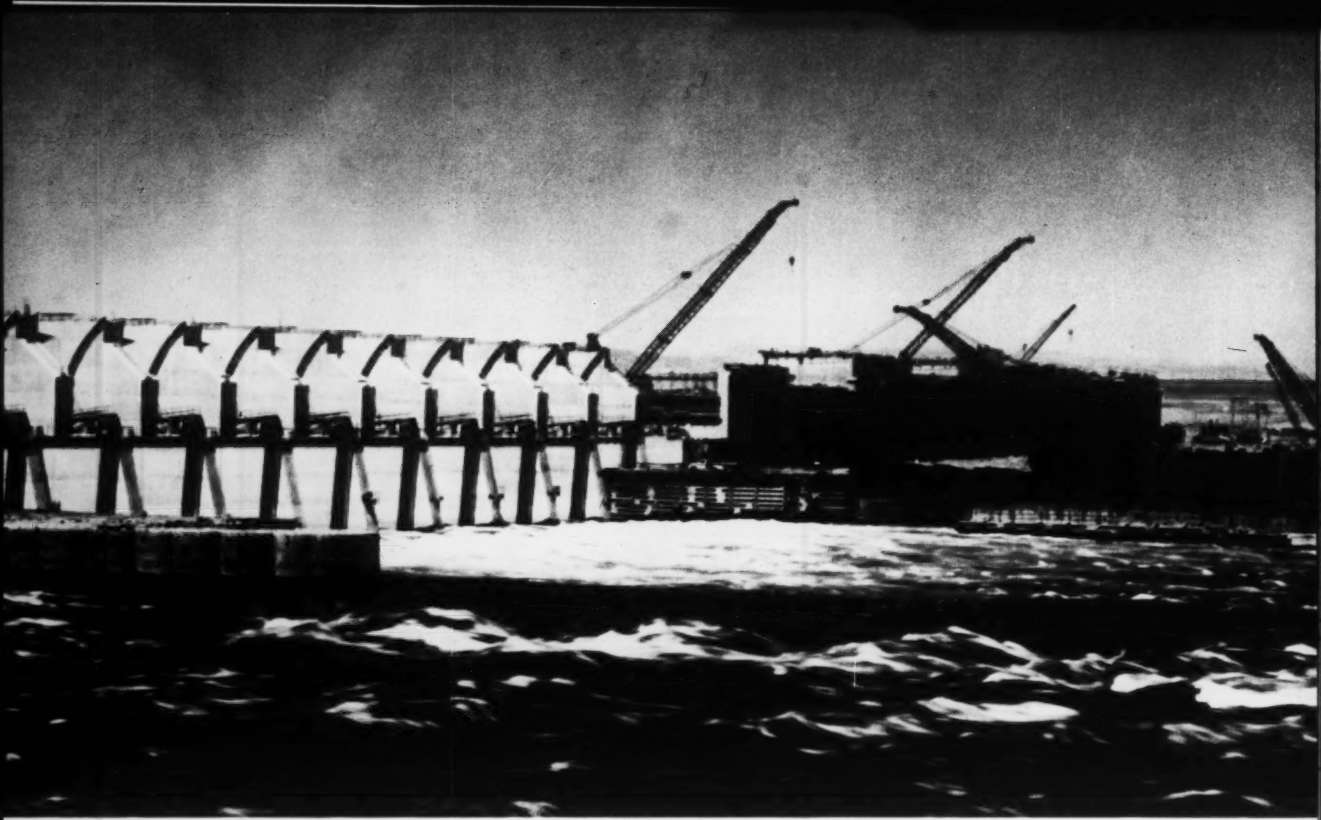


MISSILE BASE—Future launching pad for one of the Atlas missile launching bases under construction near Spokane, Wash. The project manager for MacDonald-Patti-Scott-Leavell, the general contractor, commented that each pad seems to be more steel than concrete, a construction necessary to withstand the impact of an Atlas launching.

HERE'S A PARTIAL LIST:

Road-form stakes • bar mats • hinged bar mats • reinforcing for continuous paving • welded fabric • dowel units and hook-bolt center-joint dowels • trapezoidal keyways • dowels for longitudinal contraction and expansion joints • expansion hook bolts for pavement widening • center strips and pins.

BETHLEHEM STEEL



PRIEST RAPIDS DAM Vast tonnages of reinforcing steel are needed for huge projects like this $98,000,000 dam on the Columbia River in Washington. Here, too, steel products such as steel sheet piling are extensively used plus wire rope, and others. Merritt-Chapman & Scott Corp. is building the project for the Grant County Public Utility District.

Do YOU Have These Publications?

Take a look at this list of Bethlehem publications on highway products, concrete construction, and allied fields. Just use the coupon below. The numbers in front of the publications also appear in the coupon. Circle those you'd like to receive.

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Applications for Admission to ASCE, Jan. 30-Feb. 27, 1960

Applying For Member

John Cecil Adams, Jr., Boston, Mass.
Bennie Arnold Anderson, Washington, D. C.
Robert Cushman Arey, New York, N. Y.
Walter Ludwig Aurnhammer, Summit, N. J.
Robert Frank Balcerzak, Medina, N. Y.
Arthur Deryck Bastiman, Yorkshire, England
Donald Frederick Baumann, Milwaukee, Wis.
Ramnarainlal Nandalal Bhandari, Raipur, India
Jorge Jaques Bohm, New York, N. Y.
Sidney Breese Bowne, Jr., Mineola, N. Y.
Robert William Brown, London, England
William Calvin Burkett, Wilmington, Del.
Francis Joseph Connell, Binghampton, N. Y.
Carey Cottingham, Downers Grove, Ill.
Horace Robert Coulter, Baltimore, Md.
Robert Henry Day, Jr., Los Angeles, Calif.
Luis Federico Diez Gonzalez, Santurce, Puerto Rico
Peter Edington Ellen, Wellington, New Zealand
John Clinton Fellows, Jr., Toms River, N. J.
David Fisher, Los Angeles, Calif.
William Henry Fitzgerald, Boston, Mass.
Arthur Calvin Ford, New York, N. Y.
Philip William Genovese, New Haven, Conn.
Alfonso Golderos, Mayaguez, Puerto Rico
Donald Weber Harrington, Chicago, Ill.
John Joseph Stanley Hempel, Roselle, N. J.
David Ira Henderson, Kansas City, Mo.
Grove Robert Holcomb, Reno, Nev.
David Grant Huber, Hamilton, Ontario, Canada
Ernest Gerald Hurst, Hillsboro, Ill.
Fred Raymond Ingram, Whitestone, N. Y.
John David Isherwood, Los Angeles, Calif.
Boris Jermakov, New York, N. Y.
John Lester Keenan, Philadelphia, Pa.
Arthur Alan Klein, Philadelphia, Pa.
Robert Samuel Knight, Scottsdale, Ariz.
Alvan Ernst Koch, Odessa, Tex.
Donald Edward LeBeau, Wilmington, Del.
Charles Nicholas Ludman, Pittsburgh, Pa.
Ronald William MacKichan, Vancouver, B. C., Canada
George Victor Marangoni, Cleveland, Ohio
Ian William McCaig, Niagara Falls, Ontario, Canada
Douglas Malcolm McCallum, South Africa
Robert Lawrence McDonell, Sacramento, Calif.
Morton Merron, New York, N. Y.
William Lester Morris, Missoula, Mont.
Arthur Carroll Edward Oberton, St. Albans, W. Va.
Paul Dumzo Ofili, Columbus, Ohio
LeRoy Edward Ohsiek, Honolulu, Hawaii
Richard Henry Olney, Boston, Mass.
Dwight Lawson Paisley, Jamaica, West Indies
Chandrakant Baburao Patel, Calcutta, India
Zaheeruddin Pathan, Karachi, Pakistan
Gordon Rex Pennington, Glendale, Mo.
Arthur Herman Pera, St. Paul, Minn.
Henry John Plock, Jr., Tehran, Iran
James Fraser Pool, Johannesburg, South Africa
John Claude Potter, Jr., Fort Benning, Ga.
Gustave Olivier Prados, Nashville, Tenn.
Walter Raketich, Jr., Los Angeles, Calif.
Charles Clarence Ranney, Kalamazoo, Mich.
Kenneth William Sax, Sacramento, Calif.
Frank Roy Scarlett, Detroit, Mich.
Ruth Gordon Schnapp, San Francisco, Calif.
Paramanahalli Venkataswamygowda Somasekhara, Cambridge, Mass.
Harold James Spelman, Jr., Washington, D. C.
Percy Gordon Spencer, Essex, England
John Francis Stachowicz, Pittsburgh, Pa.
Donald Willard Stenzel, Cleveland, Ohio
Dmitro Celestin Stopkey, Ottawa, Ill.
John Tillman Talbert, Jr., Wilmington, N. C.
Max Rudolph Willy Teicke, Caracas, Venezuela
Charles Benjamin Trueblood, Middletown, Ohio
Clifford Haig Turner, Calcutta, India
William Allen White, Florence, Ala.
Sheldon Edward Winks, Kenmore, N. Y.
Long-po Wu, Denver, Colo.

Applying For Associate Member

Fausto Abril O, Baltimore, Md.
Edward Gregory Altouney, Sacramento, Calif.
Carlos Alberto Padua Amarante, Gerais, Brazil
Charles Newton Bainbridge, Decatur, Ill.
Lincoln Virgilio Barbugiani, Sao Paulo, Brazil
Marvin David Barkan, New York, N. Y.
Lars Stefan Bergenhem, Richmond, Va.
Geoffrey Fallows Buck, Montreal, P. Q., Canada
Philip Dale Cady, Aruba, Netherland Antilles
John Henry Cervant, Topeka, Kans.
Devarayasamudram Visweswaraiya Chandrasekhara, Evanston, Ill.
David Lee Cooksey, Vicksburg, Miss.
Eduardo Buenaventura De Bello Pedreschi, Columbus, Ohio
Herbert James Dix, Palos Park, Ill.
Joseph Warren Dold, Cincinnati, Ohio
John Stephen Duffy, New York, N. Y.
Charles Warren Duncan, Kansas City, Mo.
William Joseph Fecko, Pittsburgh, Pa.
Richard Arthur Foley, West Newton, Mass.
Rudolfo Gonzalez Morasso, Baltimore, Md.
Joseph Henry Heinz, Jr., State College, Pa.
Warren Harold Hilger, New York, N. Y.
Arthur Yau Yuen Ho, Fredericton, N. B., Canada
Donald Elmer Huffman, Dixon, Ill.
Bernard Charles Hughes, Fort Belvoir, Va.
Irving Katz, Brooklyn, N. Y.
Gerard Roger Kenly, San Jose, Calif.
T. N. Khoury, Chicago, Ill.
Kenneth Kruger, San Francisco, Calif.
Joseph Daniel Lake, Lansing, Mich.
Edwin Francis Leone, Heilwood, Pa.
Paul Lew, Oroville, Calif.
David Henry Lillard, Kansas City, Mo.
Ray Daniel Looper, Raleigh, N. C.
Sarveshwari Prasad Mathur, Saharanpur, India
Joseph Aloysius Meyer, Rolling Meadows, Ill.
William Michael Moore, College Station, Tex.
Khuram Jah Murad, Dacca, East Pakistan
Ronald Lee Ovenden, New Orleans, La.
Ney Pickett Park, Jr., Montgomery, Ala.
Goh Boon Peng, Kuala Lumpur, Malaya
Tommy Jay Pickering, Jackson, Miss.
Nasim Mohammad Qureshi, St. Paul, Minn.
Joseph Richard Read, Rayville, N. J.
Donald Anthony Recchio, Bethlehem, Pa.
Mario Gabica Revilla, Springfield, Ill.
Earl Lyman Sack, Minneapolis, Minn.
James John Schuster, Villanova, Pa.
James Leroy Seedenburg, Monsey, N. Y.
George Bernard Sigal, New York, N. Y.
Thomas Franklin Smith, Columbia, S. C.
Joseph George Stassi, New Orleans, La.
Elmer Eugene Stout, Bloomfield, N. J.
Wayne Allen Stufft, Omaha, Nebr.
John Suski, Kansas City, Mo.
Hubert Gerold Tester, Istanbul, Turkey
Edgar Vaughn Tunstall, Sacramento, Calif.
David Warren Vories, Miami, Fla.
Leigh Franklin Vrooman, Pittsburgh, Pa.
Cho Yee Yong, Stanford, Calif.

[*Applications for the grade of Associate Member from ASCE Student Chapter Members are not listed.*]

Non-ASCE Meetings

Air Pollution Control Association. Annual meeting at the Netherland Hilton Hotel, Cincinnati, Ohio, May 22-26. Arnold Arch, Executive Secretary, APCA, 4400 Fifth Avenue, Pittsburgh 13, Pa.

American Institute of Industrial Engineers. Annual meeting at the Dallas-Sheraton Hotel, Dallas, Tex., May 12-14. AIIE, 145 North High Street, Columbus, 15, Ohio.

American Water Works Association. Eightieth annual conference at Bal Harbour, Fla., May 15-20. Conference headquarters will be the Hotel Americana. Raymond J. Faust, Secretary, AWWA, 2 Park Avenue, New York 16, N. Y.

American Welding Society. Forty-first annual convention and welding exposition at the Biltmore Hotel and the Great Western Exhibit Center, Los Angeles, Calif., April 25-29. AWS, 33 West 39th Street, New York 18, N. Y.

Building Officials Conference of America. Forty-fifth annual convention at the Eden Roc Hotel, Miami Beach, Fla., May 23-26. O. M. Pushkin, Chairman, BOCA, 1525 East 53rd Street, Chicago, Ill.

Engineering Institute of Canada. Seventy-fourth annual general and technical meeting at the Royal Alexandra Hotel, Winnipeg, Manitoba, May 25-27.

International Public Works and Building Equipment Exhibition. Second International Exhibition at Le Bourget Airport, Paris, France, May 19-29. Exhibition Secretariat, 1, Avenue Niel, Paris XVII, France.

Wire Reinforcement Institute. Annual Spring meeting at The Greenbrier, White Sulphur Springs, W. Va., May 30-31. Frank B. Brown, Managing Director, WRI, National Press Building, Washington 4, D. C.

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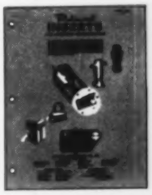

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ENGINEERING SOCIETIES PERSONNEL SERVICE, INC.

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These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which cooperates with the national societies of Civil, Electrical, Mechanical, Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or non-members, and is operated on a non-profit basis. If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 5 percent of the first year's salary if a non-member, or 4 percent if a member. Also, that you will agree to sign our placement fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include 8 cents in stamps for forwarding application to the employer and for returning when possible.

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CHICAGO
29 E. MADISON ST.

SAN FRANCISCO
57 POST ST.

Men Available

Project Manager or Construction Engineer, A.M. ASCE, B.S.C.E., Illinois Professional Engineer License, 33. Nine years of construction experience for electric and gas utility on generating station and pipeline, including supervision, liaison, surveying, inspection, and estimating and one year in field office of hydro-electric station. Location desired, Illinois. C-1052-Chicago.

Soils and Foundation Engineer, A.M. ASCE, B.C.E., M.S.E., 26. One year on soil mechanics research, and three years with the Civil Engineer Corps, U. S. Navy. C-1061-Chicago.

Civil Engineer, A.M. B.C.E. Field work with private contractors and construction inspector for federal government, some design experience. C-525.

Project Manager-Estimator, M. ASCE, Bachelor of Architectural Engineer. Broad experience in construction, estimating and design of waterfront and harbor facilities, major bridges, pneumatic caissons, braced and cellular cofferdams, pile driving, and heavy foundations for mills and buildings. C-526.

Civil Engineer, A.M. ASCE, B.S.C.E., B.S. Mining Engineering. Five years of broad civil engineering experience including two and one half years with consulting firm as planning engineer and two years as officer with Corps of Engineers. Location desired, East, Florida or Midwest. C-527.

Contract Administrator, M. ASCE, B.S.C.E., 36. Experienced on dam, highway construction; wishes similar work growing responsibilities, and permanent location (Southern New York; Florida). C-528.

Civil Engineer, A.M. ASCE, B.C.E. M.B.A. Six years of experience in the Corps of Engineers, Regular Army as Captain; followed by two years of graduate study in business administration, specializing in general management and finance, to be completed in May 1960. Commanded an engineering construction company of 150 men, supervising earth work, bridge and road building, and airfield construction. C-529.

Civil-Management Engineer, A.M. ASCE, B.C.E., M.I.E. Three years as office engineer on highway construction project, six months on industrial building design and six months on military construction. Seeks responsible position with growth potential. Location desired, Metropolitan New York area. C-530.

Structural Engineer (Foundations), A.M. ASCE, B.C.E. and M.S. Designed and prepared plans, specifications, design analyses and other addenda relative to foundations, earth work, site work and pavements (flexible and rigid). C-531.

Construction Project Manager, M. ASCE, Civil and Mechanical degree. Over 31 years of experience in design and construction of industrial plants. Location desired, East. C-532.

Field Engineer-Heavy Construction, A.M. ASCE, B.S.C.E. Chief of party on all types of surveys and construction. Structural design in reinforced concrete, steel and aluminum for power company. C-533.

Executive Engineer, F. ASCE, B.C.E. Ten years on design, service, sales and production of process equipment with staff level studies and reports of profitability and organizational efficiency. Location desired, northern New Jersey or New York City. C-534.

Construction Administrator, F. ASCE, degree in Civil Engineering. Construction engineer and administrator in general contracting with reputable and well established firm in New York City for 25 years. Will invest in same or allied going venture. Interested in the consulting field. Location desired, Metropolitan New York or New Jersey. C-535.

Resident Superintendent, A.M. ASCE, C.E., Professional Licenses in California, Oregon and Washington, 40. Fourteen years of experience supervising design, construction, surveying, estimates on highway and bridge projects, tunnels, camp housing, docks and dock repair. Salary, $10,800 a year. Location desired, West Coast or Foreign. Se-1086.

Superintendent, M. ASCE, CE, Licensed Civil Engineer, 50. Twenty-one years experience in charge of construction, cost estimates, budgets, bidding, design on industrial and commercial buildings, military projects, highways, irrigation and power projects. Salary about $20,000 a year. Location desired, Foreign. Se-789.

Soil Engineer, M. ASCE, CE, 26. Experienced in field soils testing and programming. Some design experience and report writing. Prefers soils test and design with office and field work. Limited travel. Salary, $6,300 a year. Location desired, California, Europe. Se-921.

Project or City Engineer, M. ASCE, MSCE, Registered CE, Washington, 30. Desires position with company offering promotional opportunity. Five years of experience in structural design, municipal engineering and construction practices. Salary $8,400 a year. Se-800.

Assistant to President, Manager, M. ASCE, CE (England) 46. Twenty-six years of experience in charge of site selection, exploration, and acquisition, management, supervising design and construction on cement plants, defense projects, atomic research, oil refineries, water supply and sewerage. Salary, $15,000 a year. Location desired, San Francisco, California. Se-858.

Designer, Field Engineer, A.M. ASCE, CE, 30. Four years of experience in charge of survey crews and inspection on highway, planning work, labor, materials and equipment; also summer work as instrumentman and draftsman on oil production and electric power. Salary, $7,500 a year. Se-858.

Structural Designer, Detailer, M. ASCE, CE, California Civil Engineer License, 58. Thirty years of experience on structural design for contractors, steel companies, oil refineries and self-employed as consultant. Salary, $7,200 a year. Location desired, San Francisco Bay Area. Se-1546.

Construction Superintendent, M. ASCE, CE, Licensed Civil Engineer California, Louisiana, New York, 41. Experienced as project engineer and construction superintendent on light and heavy industrial construction including steam power plants. Desires position as engineer or supervisor with consulting engineer or contractor. Salary, $10,800 a year. Location desired, West Coast. Se-1531.

Soils or Hydraulic Engineer, M. ASCE, PhD in CE, 32. One year in charge of soils, hydraulics, stability and foundation analysis for consultant; four years as hydraulic engineer in the design of earth dams, irrigation and drainage systems (China). Salary, $8,400 a year. Location desired, California or East Coast. Se-1515.

Chief Engineer, M. ASCE, CE, 33. Nine years of broad civil, structural and mechanical engineering experience, capable of coordination, supervision and design of public utilities, general structures and drainage facilities. Evaluation of existing facilities and compilation and presentation of feasibility reports. Salary, $12,500 a year. Location desired, Northern California. Se-1471.

Field Engineer, Estimator, A.M. ASCE, 55. Eleven years of experience as field engineer and inspector, chief estimator for missiles manufacturing plant and facilities, air bases, storage tanks, harbors, tunnels, tire manufacturer, public works, atomic energy commission bldgs.; for constructors, architects, manufacturers. Salary, $9,000-$10,000 a year. Se-1399.

Office, Field Engineer, M. ASCE, CE, 38. Ten years of experience in heavy construction, engineering design, office and field, port facilities, railroad design and construction and estimating. Salary, $9,000 a year. Location desired, San Francisco Bay Area. Se-1379.

Positions Available

Assistant Village Engineer, C.E. degree, with Minnesota registration or eligible for registration within six months. Three years of experience in water and/or sewer engineering, to assist in the design of water or sanitary sewer facilities, for new installation. Salary, $6,972-$7,320 a year, plus approximately $100 a month fringe benefits. C-7981.

Research Engineer, graduate C.E., architecture or structural, with up to three years of experience in building construction, design or research. Knowledge of building desired. Duties: Research on pneumatically applied mortars. To study methods, specimens, test, design and construct small building built with pneumatically applied mortar for an association. Must be U.S. citizen. Employer will pay placement fee. Salary, $7,800 a year. Location, Chicago. C-7976.

Chief Engineer, CE. Mature, with broad background in design for general contractors office. Should be a licensed engineer or eligible to be licensed. Must be capable of writing a thorough and well-organized engineering report. In addition to design work, will help coordinate construction jobs in progress. Some travel will be involved in the job, such as contact work with prospective or present customers. Excellent opportunity in a young, aggressive contracting company. Salary open. Location, Ohio. C-7963.

District Engineer, B.S.C.E., 25-35. Two years of experience on structural concrete building or estimating necessary to prepare drawings and bills of material of scaffolding or shores for shoring of structural concrete slabs. Duties will also include direct contact with builder personnel, work out shoring construction detail and to assist in installation of shoring equipment; occasional travel, car required; for a manufacturer of scaffolds. Employer will pay placement fee. Salary, $8,000 a year. Location, Chicago. C-7957.

Head, Structural Drafting Department, B.S. structural, civil or architectural engineering, to 50. Five years of experience in drafting department of structural steel fabricator with knowledge of structural shop practices and methods. Will have charge of medium sized detailing department for fabricator of structural steel and concrete reinforcing steel. Must be able to lead and train men and be able to work cooperatively with key men within organization as well as customers, architects, etc. Must be cost conscious and alert to new ideas for cost reduction for a steel fabricator. Salary, $7,000-$9,500 a year. Employer will negotiate placement fee. Location, North Dakota. C-7956.

Engineers for a consulting engineering firm specializing in city and regional planning who are qualified for the following: *(1)* Civil engineering; *(2)* Utility planning; *(3)* Hydrology; *(4)* Water resources study; *(5)* Land development; *(6)* Site planning; *(7)* Economic studies; *(8)* City Planning activities. Salaries open. Location, Pennsylvania. W-8722.

Engineers. *(a)* Structural engineer, 30 to 40, specialist in reinforced concrete design and construction for product design and application studies with large manufacturer. Should be well versed in reinforced concrete theory and practice, both ordinary and prestressed. Teaching experience desirable but not necessary. Will involve design of steel products for use in concrete construction, application studies of steel products and similar work. Salary open. *(b)* Civil and mechanical engineers, experienced, for product design and application studies with large steel manufacturer. Work involves design of steel products, engineering studies relating to application of steel products in all fields. Must have strong theoretical background. Salary open. Location, East. W-8718.

Civil Engineer, graduate, registered engineer, capable of assuming direction of municipal public works and engineering department for good sized middle west city. Must be citizen of U.S. Salary open. W-8714.

Specifications Writer, graduate civil, with at least five years of experience in preparation of technical construction specifications; also field experience in heavy construction. Will be responsible for preparation of technical specifications (excluding mechanical and electrical) for contract documents covering heavy construction such as dams, irrigation and drainage, highways, airports, railroads, waterfront, sewers and watermains. Location, New York City. W-8682.

Track Supervisor, R.R. Construction, graduate civil preferred, single status preferred; with a minimum of three years in responsible charge on track construction or maintenance. Will act as liaison with surveyor on staking; materials on ballast requirements and availability; inspection of line and grade; inspection of electric butt welding of rail; interpret specifications; pass change orders and claims, etc. Some knowledge of French desired. Salary, $12,000-$13,200 a year. Location, northern Canada. F-8681.

Design Engineer, recent graduate civil or mechanical, for preparation of detailed drawings and changes in plant facilities and structures, analyzing of maintenance and engineering problems in connection with mine, concentrating and sintering departments. Location, East. W-8657.

Construction Manager, degree in civil or structural engineering, 38 to 45, with broad experience in the construction industry, mostly on large industrial buildings, apartments and Class A office buildings. Must be very cost, profit and control conscious and have some appreciation for time and motion studies as applied to the construction industry. Will report to President of company. Salary, $15,000 a year range; car and expense account. Limited travel. Location, southern California. W-8635.

Assistant to General Contractors' Project Manager, civil engineer, for airfield construction project, with five or six years of experience on comparable work. Allowances include transportation for dependents and personal automobile. Location, Near East. F-8609.

Structural Designers fully experienced in highway bridge design, for consulting engineering firm expanding operations in New England. Salary open; opportunity for advancement. Employer plays placement fees. Location, Connecticut. W-8593.

Resident Engineers, (1 for Los Angeles, 1 for Oregon), degree or equivalent, to 55. Minimum five years of field and office experience relating to construction of chemical plants. Will handle work schedule and progress, field changes, evaluate costs and bid estimates and administer contracts with general contractors, subs, architects and other construction trades for chemical manufacturer. Opportunities exist to become familiar with owner's standards and requirements and deal with foregoing problems encountered in erection of plants in Southern California or Northwest U. S. Applicants should be residents of Southern California or Oregon regions. Salary, $10,000 a year. Sj-5104-R.

Sales Engineer, Architectural or CE, late twenties. Two to four years of experience in dealing with architects and others in building business. Should be able to work directly with users, dealers or engineers and deal with proposals, specifications and plans for manufacturer of curtain wall and other panel products. Cover San Francisco to San Jose. Car provided. Local men only. Salary, $7200 a year, plus incentives. Sj-5101.

Office Engineer, CE, prefer Registered in California, 32-45. Minimum of six years of experience related to design and construction of canals and irrigation structures. Under limited supervision to prepare plans and specifications for consultant with established practice in Central California. U.S. citizenship required. Discuss payment of placement fee with employer. Salary open, depending on qualifications. Location, San Joaquin Valley. Sj-5091-R.

Highway Designers, From draftsmen through engineers for placement in bridge, road traffic and drainage sections for a state highway commission. Will consider engineers in any phase of highway engineering. Salaries Open. Location, Southwest. Sj-5085.

Design Draftsman, to 45. Two years of experience in consultant's office working on wood, steel and concrete framing and foundations for commercial and public buildings required. Must be able to draft cleanly and rapidly and prepare details for a consult. Later may engage in more important design work. Salary, $3.00-$4.00/hour. Location, San Francisco. Sj-5082.

Civil Designer, Graduate, registered CE in California, to check site plans, figure drainage, elevation, engineering for construction of hospitals, schools, public buildings mainly for consultants. Salary open. Location, San Francisco. Sj-5072.

Sales And Design Engineer, CE or sanitary engineering background, with good experience working with state, government or sanitary engineering firm, recognized as tops in sanitary field. For manufacturer on sales, design of sewage treatment plant and equipment. Salary about $10,000-$12,000 a year. Location, San Francisco Peninsula. Apply by letter. Sj-5071.

This is only a sampling of the jobs available through the ESPS. A weekly bulletin of engineering positions open is available at a subscription rate of $3.50 per quarter or $12 per annum for members, $4.50 per quarter or $14 per annum for non-members, payable in advance.

Estimator, general contracting background, age open. Experienced in take-off and estimating for bid purposes, primarily on fabricated steel buildings with some knowledge of concrete footings and slabs. Ability to do simple drafting for general contractor and manufacturer's agent. Salary, about $6000 a year. Location, San Francisco East Bay. Sj-5068.

Designer, CE or equivalent, age open. Should be qualified as designer of highways and subdivision; computing maps and layout of improvement plans; also able to work on the board for a consultant civil engineer. Salary commensurate with experience. Location, Sacramento. Sj-5051.

Senior Design Draftsman, CE or architect, preferably with mechanical and electrical experience, preferably married, under 40. Needs person with good drafting ability as well as design experience in architectural-engineering for top staff position. To work on schools, military, water and sewerage, commercial, industrial and public buildings, subdivision. Salary open. Location, Southern California. Sj-5109-R.

Superintendent, CE graduate, with five to ten years of experience in heavy construction to take responsible charge of field operations and assist project manager in coordination and administration of entire waterfront construction project. Salary, $9,600-$10,800 a year, depending on experience. Location, southern California. Discuss payment of placement fee with employer. Sj-5048.

Senior Estimator, CE, ten to fifteen years of experience in building construction, some field. Will engage primarily in estimating and completing bids for general contractors on large office buildings or similar structures (not roads, dams or bridges). Salary, $9,600 a year up, depending on experience. San Francisco. Sj-5104.

Sales Engineer, StructlE or CE, 28-35, Minimum three years of experience designing steel concrete and wood to sell plywood structural components for box beams, stressed and curved panels, etc. Knowledge of estimating helpful. Salary open, depending on ability and experience. Employer will negotiate for payment of placement fee. Location, California. Sj-5069.

Sales Engineer, building background, age open. Should be qualified to deal with prospective clients or general contractor (B-1 category); knowledge of design and construction, field engineering and superintendency and engineering architectural and construction requirements for commercial and industrial type buildings. Should be a "closer". Able to get business for a contractor. Salary, $6,300-$8,320 a year, plus mileage; car required. Location, San Francisco Bay Area. Sj-5009.

Field Or Office Engineer, CE or other engineering degree, under 30. Prefer minimum of two years' work experience with military training completed and some familiarity with construction plans, specifications and building methods. After ten weeks of training in eastern headquarters will engage in inspection work related to fire insurance in firm's district office. San Francisco Headquarters. About $6,000. Sj-5056-R.

AMERICAN SOCIETY OF CIVIL ENGINEERS

Reno Convention

June 20-24, 1960

Mail to:

ASCE HOUSING COMMITTEE
P. O. Box 2607
Sacramento 9, California

Please indicate 1st, 2nd, 3rd choice and circle room desired:

	Single	*Double*	*Twin*
☐ Holiday	$8–14	$11–17	$12–18
☐ Mapes	$10	$14	$16
☐ Riverside	$9	$14	$14

DATE AND HOUR OF ARRIVAL ....

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All three "official hotels" are situated within one block of Registration Desk in State Building

OKLAHOMA PROJECT I-205 (5) Interstate Route 40

Oklahoma builds to last...with "DEEP-STRENGTH" Asphalt pavement

- **Hot-mixed—hot-laid Asphalt base promises outstanding service life.**
- **Design overcomes problems of plastic subsoil and short aggregate supply.**

Down in Oklahoma, they've just completed a beauty . . . a new *Deep-Strength* Asphalt pavement that includes many features of The Asphalt Institute's Advanced Design Criteria.

And it won't be the last. That's for sure.

Just take a look at the construction (right) and cross section (below). Notice that precepts of new *Deep-Strength* Asphalt design are incorporated...heavy-duty Asphalt concrete surface course . . . heavy-duty Asphalt base . . . Asphalt primed subbase . . . wide double-sealed Asphalt shoulders (on Asphalt base) . . . heavy compaction . . . good drainage.

When designed like this — for *Deep-Strength* . . . Asphalt pavements will carry the heaviest traffic loads without distress . . . with minimum maintenance cost. Witness the New Jersey Turnpike. Witness also *Deep-Strength* Asphalt city pavements built more than 60 years ago and still in service.

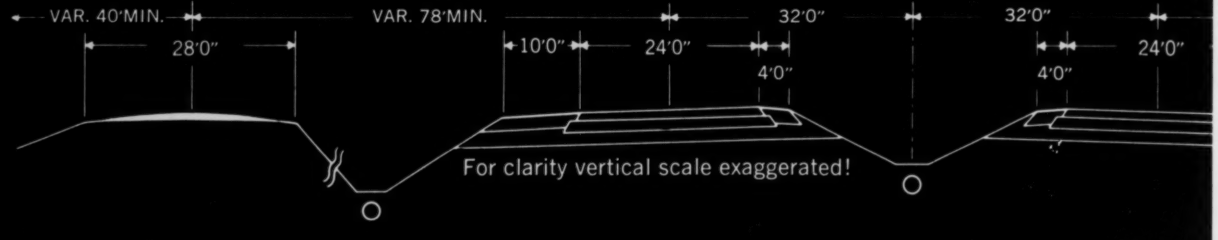
Save money, too

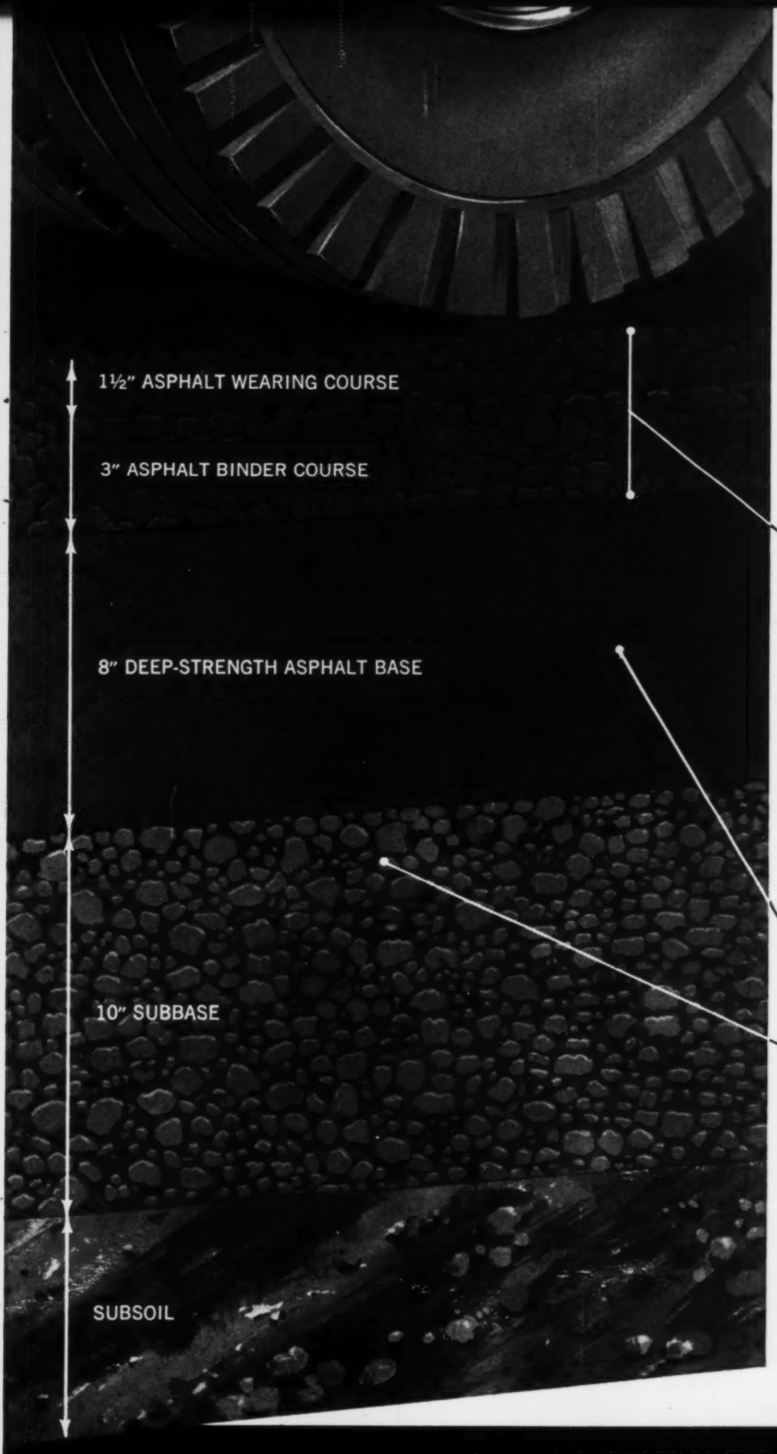
Surprising as it seems at first glance, modern low-maintenance, *Deep-Strength* Asphalt pavements often cost less to build than Asphalt pavements designed to other standards. That's because the Advanced Design Criteria permit inexpensive Asphalt base to be substituted, within limits, for the more expensive Asphalt concrete surfacing. And also because total pavement thickness can often be reduced by several inches.

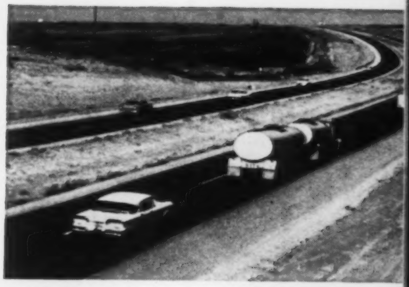
New Handbook

Now on the presses is a new edition of The Asphalt Handbook. It incorporates all the Advanced Design Criteria for highways implied by the term *Deep-Strength* Asphalt Construction. Copies soon will be available at The Asphalt Institute office serving your area.

DEPRESSED MEDIANS ASSIST FREE DRAINING. Note also the Asphalt shoulder construction. These two measures alone can substantially



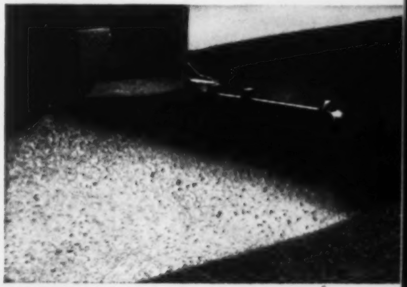

1½" ASPHALT WEARING COURSE
3" ASPHALT BINDER COURSE
8" DEEP-STRENGTH ASPHALT BASE
10" SUBBASE
SUBSOIL



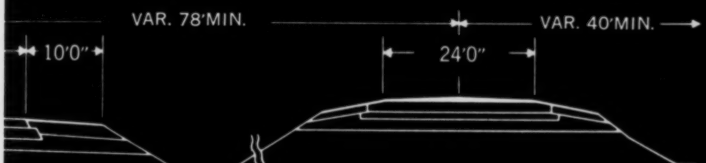
4½-INCH ASPHALT CONCRETE SURFACE takes heaviest traffic, deicing salts without distress. Lane markings show up better day or night, wet or dry.

8-INCH SAND-ASPHALT BASE provides Deep-Strength . . . excludes moisture, insures smoother riding surface under heaviest traffic.

ASPHALT PRIME COAT SEALS SUBBASE . . . insures bond with overlying Asphalt base.



lengthen pavement life.


VAR. 78'MIN.
VAR. 40'MIN.
10'0"
24'0"

*Ribbons of velvet smoothness . . .
ASPHALT-paved Interstate Highways.*

DEEP-STRENGTH

THE ASPHALT INSTITUTE
Asphalt Institute Building, College Park, Maryland

1 ACETOGRAPH PEN

Koh-I-Noor Pencil Company, Inc.—Information has been published on the Acetograph Pen, which is excellent for drawing, writing and lettering, in black or colors, on plastics. It has its own built-in automatic filling system and is equipped with a quality pocket clip. Transparent Acetate inks are also discussed in this brochure.

2 ADMIXTURES, SEALANTS AND COATINGS

Sika Chemical Corporation—A Data Book describes the complete line of chemical products for use in concrete construction with application and coverage data. They are Plastiment Retarding Densifier for increased strengths and Igas Joint Sealers for long lasting water-tight construction joints and self-sealing membranes, Rugasol for exposing aggregates, epoxy compounds, quick setting products for stopping leakage, and various surface treatments grouting and mortar additives.

3 AERATION IN SEWAGE & WASTE TREATMENT

Walker Process Equipment Inc.—Bulletins 22-S-61 and 22-S-90 cover the Sparjair aeration unit for sewage and waste treatment processes. Sparjers provide a high rate of tank turnover and oxygenation efficiency and include a number of operating features. They are practically clog-proof and self-cleaning and do not build-up back pressure. No air filters are required. The history of their development, theory of operation and engineering details is presented in these two bulletins.

4 AIDS FOR DRAFTSMEN

Keuffel & Esser Co.—"Keep It Clean!," a 6-page, gate-fold bulletin describing materials to help draftsmen clean and protect drawings, is offered. The brochure is printed in two colors and contains four illustrations. Order numbers and prices are listed for cleaning aids and protective spray marketed by the company.

5 AIR ENTRAINING METER

Charles R. Watts Co.—A new folder is available covering admixtures and air entraining agents and describing the Press-Ur-Meter, a device for determining the air content of fresh concrete. Said to be extremely fast, the Press-Ur-Meter follows the Klein-Walker application of Boyles Law, simplifies the usual testing procedure, using only about one tablespoonful of water, which is added on top of the sample to insure accuracy, the manufacturer reports. No adjustments for varying barometric pressures are necessary.

6 AIR METER FOR LIGHT WEIGHT AGGREGATE

Charles R. Watts Co.—Full information is available on the Roll-A-Meter, a device for testing both standard aggregate concrete and light weight concrete made of cinders, manufactured aggregate, pumis, etc., and is covered by the ASTM Designation C173-55T.

7 ALL WEATHER RUNNING TRACKS

American Bitumuls & Asphalt Company—A booklet on a new approach to construction of oval tracks for track meets has been announced. This Grasstex Track (proved at the University of Florida) offers low initial cost; very low maintenance; year-round utility; and fine performance experience.

8 ALUMINUM GRATING

Borden Metal Products Co.—A brochure by way of diagrams and photos illustrates the properties and use of aluminum floor gratings. Also shown are tables of their specifications. A description of safety grating and aluminum safety steps is featured.

9 ALUMINUM GRATING

Rockwell-Standard Corporation, Grating Div.—This 6-page brochure gives engineering data on Gary Super Galok Aluminum Grating, which is non-rusting and corrosion resistant. Exclusive design provides a high strength-to-weight ratio, minimum deflection, greater installation ease and maximum safety.

10 ALUMINUM GRATING AND TREADS

Irving Subway Grating Co., Inc.—This Aluminum Grating catalog contains illustrations, descriptions, loads and spans table, weights, and other engineering data on aluminum riveted, pressure-locked grating products, for use as flooring, treads, walkways and trench covers. They are light weight, non-rusting, self-draining, self-cleaning, ventilating, fireproof and economical.

Mail This COUPON To-day

CIVIL ENGINEERING Date............

33 West 39th St., New York 18, N. Y.

Please have the literature indicated by the circled CATALOG DIGEST numbers in the April 1960 issue to me without obligation.

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Position ....

Firm Name ....

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City, Zone and State ....

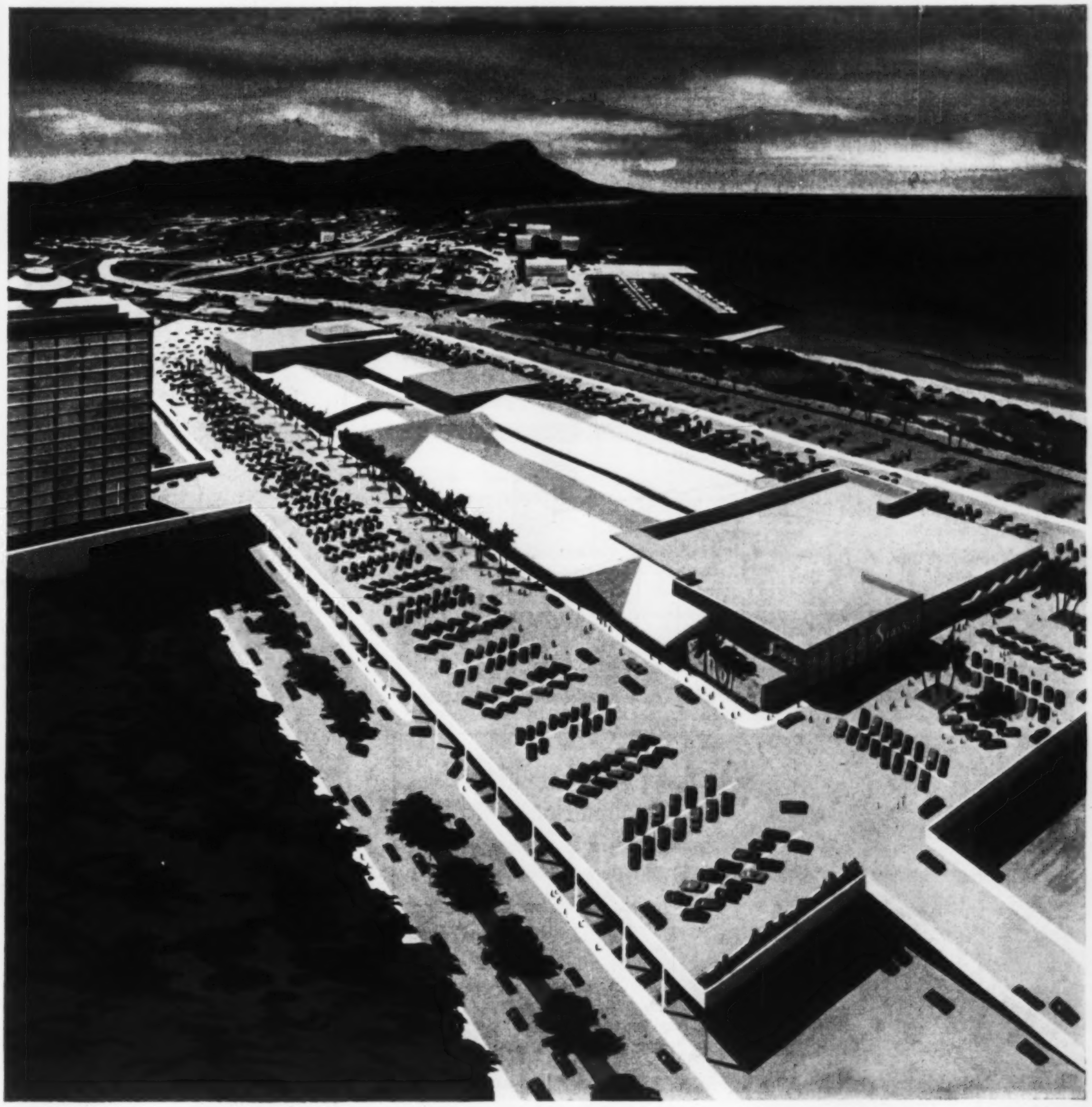
NOT GOOD AFTER MAY 15, 1960, for readers in the U. S., but requests will be accepted to June 30, 1960, from readers outside of this country.

PLEASE PRINT
NAME CLEARLY

Use This Free Service—Mail The Coupon To-day

PRESTRESSED CONCRETE IN OUR 50th STATE

Owner, Developer and Contractor: Hawaiian Land Co., Ltd. *Architects & Engineers:* John Graham and Co. *Prestressed Consultants:* Ben C. Gerwick, Inc., San Francisco; Anderson, Birkeland & Anderson, Tacoma; Park & Yee, Honolulu *Prestressed Concrete Fabricator:* Hawaiian Dredging and Construction Co.



...HONOLULU SHOPPING CENTER WILL BE ONE OF NATION'S BIGGEST

All told, this huge complex – named Ala Moana – will cover 50 acres, have parking space for 7,000 cars and will cost some $39,500,000 on completion of phase 2, including the 25-floor office building, 1441 Kapiolani.

The use of prestressed concrete is widespread; in the beams, girders and joists for the parking deck and the 25-floor office building, in street curbing, bumper strips in the parking areas, in lamp posts and in prestressed concrete piles which serve both as foundations and columns supporting the parking deck and mall level shops.

Like all good members of the national "family," the Ala Moana developers turned to the mainland for the ultimate in stress-relieved prestressing strand for the critical members in their project; in this case manufactured by Roebling.

For over a decade, the activities of Roebling in the prestressed concrete field have embraced all phases of this remarkable and economically rewarding construction method. Architects, engineers and builders have found – in many States, both old and new – that the quality of Roebling strand, as well as the quality of Roebling engineering assistance, can't be had – *for the same satisfaction* – from anywhere else in the world.

We are immediately desirous of sharing with you our information, experience and data on prestressed concrete in all of its fascinating areas. Please address inquiries to Roebling's Construction Materials Division, Trenton 2, New Jersey.

ROEBLING

Branch Offices In Principal Cities
John A. Roebling's Sons Division
The Colorado Fuel and Iron Corporation

Now... *a 6 minute splice* for Rubber Waterstop

To splice Gates new Kwik-Seal Rubber Waterstop, all you need is a small splicing kit and simple clamping device. This eliminates the need for a field vulcanizer, molded parts, a power supply or heat.

The Gates Kwik-Seal splice is chemically bonded. The strength of the bond often exceeds the strength even of the rubber—far stronger than government requirements. *You make this strong, permanent splice in just 6 minutes—5 times faster than with former methods!*

As a result, this new Gates splicing method cuts your labor costs and speeds the job.

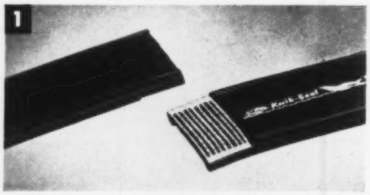
WRITE FOR CATALOG and splicing demonstration.

The Gates Rubber Co. Sales Div., Inc.
Denver 17, Colorado

Gates Rubber of Canada Ltd.
Brantford, Ontario

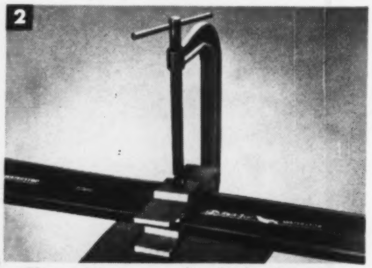
TPA 977

SEE OUR CATALOG IN SWEET'S



1

Apply Kwik-Kem bonding chemical to prepared surface.

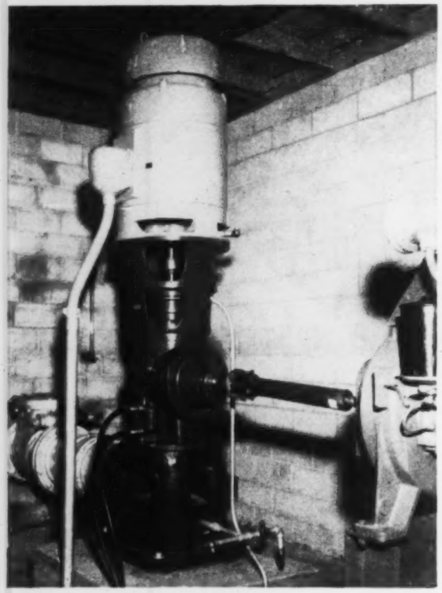


2

Clamp Waterstop firmly for 5 to 6 minutes... and it's spliced.

Gates®

Gates *Kwik-Seal* Waterstop



NEW! Automatic combination gear drive

JOHNSON

Redi-Torq®

Redi-Torq combination right angle gear drive with automatic clutch, eliminates manual switch-over to engine drive in case of power failure. Drive couples to engine by flexible shafting or couplings—engine clutch unnecessary. Engine may be tested without interfering with electric motor operation of pump.

For round-the-clock protection against power failure in water, sewage and fire installations. Developed and proven in municipal and industrial use over several years.

Sizes: 15 to 200 hp; hollow or solid shafts. Write for engineering catalogs.

JOHNSON · MAKERS OF FINE GEARS SINCE 1904

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8TH AND PARKER STREETS · BERKELEY 10, CALIFORNIA

MEMBER OF AGMA

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Smith Meeker Engineering Co., 157 Chambers St., New York City

13-R

CATALOG DIGESTS

11 ALUMINUM GRATING DESIGN

Kerrigan Iron Works Co.—A catalog on new Weldforged aluminum grating is offered. New forming process prevents cross bars from turning—eliminates the use of rivets, bolts and screws. It contains engineering data including safe load table and also stair tread data.

12 ALUNDUM AGGREGATE

Norton Co.—This 8-page booklet discusses the two features of the company's Alundum floors products—walking safety (wet or dry) and exceptional durability. Sizes, specifications, and photographs are included in this brochure.

13 APPLIED POLYMER CHEMISTRY

Thiokol Chemical Corporation—Issues of the company's publication, "Thiokol Facts", are offered. Volume 4, No. 2 contains articles on Plastic Tooling, Thiokol Liquid Polymer Enables a New Concept in Fiber Glass/Epoxy Pipes, and Flowing Modern Architectural Design Creates New Challenge For Elastomeric Sealants. Volume 4, No. 4 includes the Expanding Sealant Market and Producing Urethane Ducks.

RETURN THE COUPON TODAY FOR IMMEDIATE RESULTS!

14 ASPHALT LINER MANUAL

W. R. Meadows, Inc.—announces the availability of a "Hydromat" Asphalt Liner Manual. The "Hydromat" Manual fully describes applications and contains installation information, necessary technical engineering data and specification information. This is not a sales catalog, but strictly a Technical Data Manual.

15 ASPHALT PAVING

Texaco Inc., Asphalt Sales Div.—Helpful information on the methods and materials employed in heavy-duty, intermediate and low-cost types of Asphalt Construction for highways, streets, airports and parking areas, is supplied in two illustrated brochures. Plant-mixed pavements, asphalt penetration macadam, road-mixed asphalt surfaces and bituminous surface-treatment are covered in the literature.

16 ASPHALT PLANTS AND EQUIPMENT

Posey Iron Works, Inc., Iroquois Div.—An illustrated 22-page catalog is offered showing the company's asphalt plants, dryers, pug mills and asphalt paving equipment and tools. This colorful brochure illustrates typical installations of hot or cold mix batch type plants with capacities from 50 to 240 tons per hour. Also shown are detailed photographs of their automated control system, rotary dryers and accessories.

17 AUTOCOLLIMATING THEODOLITE

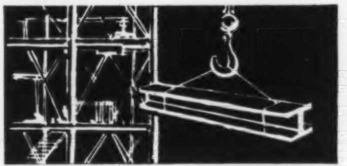
Kern Instruments, Inc.—Information is available on the Autocollimation Eyepiece, which when attached to the DKM2 1-sec Theodolite, becomes an integral part of the instrument. Total telescope magnification is 23x, working distance up to 100 ft indoors. The light source is an easily replaceable standard 3-V or 6-V bulb. The instrument can be used for normal surveying without removing the eyepiece by simply switching off the light which illuminated the reticule.

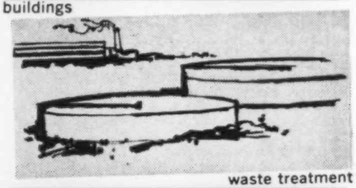
18 AUTOMOBILE FOLDER

Oldsmobile, Division of General Motors Corporation—This full color folder illustrates dramatically the models that are available of the 1960 Oldsmobile cars. Specifications and features are indicated.

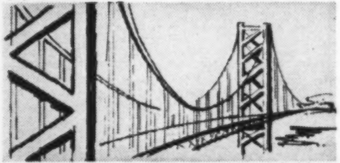
highways

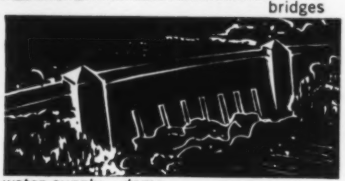
rivers & harbors

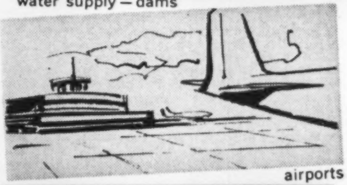

buildings


waste treatment

pipelines


bridges


water supply — dams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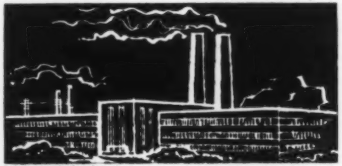
industrial plants

WHY ADVERTISING IN CIVIL ENGINEERING STIMULATES SALES IN CONSTRUCTION MARKETS

In the construction industry, four major groups account for nearly all product buying and specifying:

CONSULTANTS ■ CONTRACTORS ■ PUBLIC WORKS ■ OWNERS

Civil engineers occupy key positions in each group. Not only are they responsible for design, construction, operation and maintenance "in the field"... civil engineers are also a primary influence "behind the desk," in charge of management.

As a result of this wide responsibility, civil engineers largely control the specification and purchase of construction equipment, materials and services.

The only magazine edited exclusively to serve the technical, business and professional needs of this select audience is CIVIL ENGINEERING... official publication of the American Society of Civil Engineers.

Year after year, its circulation has increased with construction activity and the growth of the civil engineering profession. Editorially CIVIL ENGINEERING serves all areas of construction and all civil engineering interests – making it truly The Magazine of Engineered Construction.

Basic data on the civil engineer's role in different construction industry groups is being furnished by A.S.C.E. Mail Forum surveys. For example, the most recent study (of consulting engineers) revealed these facts:

- CIVIL ENGINEERING's consultant readers own or work for firms that concentrate almost entirely on *engineered construction* projects...with their work divided among the various types of construction as follows:

Airports	3.8%	Military sites	3.9%
Bridges	7.6	Pipe lines	4.6
Buildings, commercial & residential	17.9	Rivers & harbors	1.6
Dams	2.7	Waste treatment	10.9
Highways & streets	14.6	Water supply	10.1
Industrial plants	9.1	Miscellaneous	13.2

- the average annual cost of all the equipment and materials specified by each of the 290 firms reported is well over $6 million.
- 90% of the readers influence the purchase and the specification of construction materials, installed equipment and office equipment.
- their titles and functions are proof of a high degree of authority and a wide area of buying influence within their firms.

In CIVIL ENGINEERING, *advertisers reach top quality consultants concerned only with construction. This is the core of your consulting engineer market... the men who specify your products!*

And remember... whether your product is specified and purchased through consultants, contractors, architects, owners, public works officials (or any combination of these groups) you get the *most effective, most economical* coverage of civil engineers by advertising in CIVIL ENGINEERING Magazine.

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THE MAGAZINE OF ENGINEERED CONSTRUCTION

The American Society of Civil Engineers ■ 33 W. 39th St., New York, N. Y.

CATALOG DIGESTS

19 BASIC PROCEDURES OF SOIL SAMPLING

Acker Drill Company, Inc.—This book describes and illustrates the latest methods, procedures and tools used for soil sampling. Over 100 drawings illustrate the text. The price is $1.00 with a full refund if the reader is not completely satisfied.

N.B. There is a charge for this book. Make checks payable to Acker Drill Company, Inc.

20 BOGIE PUGMILL

Davis Welding and Mfg. Co.—Bulletin No. 1000-A is a 4-page brochure on the Bogie Pugmill, which produces stabilization mix up to 1000 tons per hour depending on the type of mix. A precision water meter assures the accuracy in water content that is necessary for proper compaction. Twin shafts in the pugmill give fast, thorough mixing.

21 BOILERS, BOILER-BURNER UNITS AND STOKERS

The James Leffel & Co.—Complete descriptive and specification data on rugged, reliable Scotch-type boilers for oil, gas or coal firing and automatic underfeed stokers for use with Scotch-type boilers is given in richly illustrated 28-page Bulletin 236. Descriptive literature on outstanding installations of Leffel boilers and boiler-burner units will be enclosed.

22 BORINGS

Raymond International Inc.—A booklet "Subsoil Investigations for Foundations" Catalog B-7 explains the reason for subsoil investigations, what Gow borings are and how they are made, and the results obtained. Illustrated are methods for making borings and taking samples, and various types of rigs in operation.

23 BRIDGE BEARINGS & PLATES

Lubrite Div., Merriman Bros., Inc.—This literature provides complete information about Lubrite Expansion Plates and Bushings with typical suggested design details and technical data. Lubrite Bearings are completely self-lubricating and do not require periodic maintenance or servicing. The bearings are applicable to steel and concrete structures. Special design provides for rotation of beam, due to deflection, as well as for the normal therman expansion and contraction of the span.

24 BRIDGE DECKING

Irving Subway Grating Co., Inc.—The new 12-page catalog on Irvico Decking for bridges contains illustrations, descriptions and engineering data on metal grid bridge flooring, including the special beam type decking and the new C-K surface. It points out the features which include light weight, cleanliness, drainage, safety, durability, traction, strength and economy.

25 BRIDGE FLOORING

United Steel Fabricators, Inc.—Some of the features of Structural-Plate Bridge Flooring contained in this 8-page catalog are: it provides a simple, economical, maintenance-reducing floor for new or existing highway bridges, viaducts, overpasses and similar structures; it installs rapidly and easily without special equipment; and it reduces dead load to a minimum. Engineering data, specifications and illustrations are included. Also available are a colorful brochure on rigid frame steel buildings and a 4-page booklet on Handy-Hut portable quality-all steel buildings.

26 BRIDGES

The Ingalls Iron Works Co.—This booklet features information on bridges by Ingalls—from detailing to fabrication to erection. Photographs of some of the bridges on which the company has worked are included.

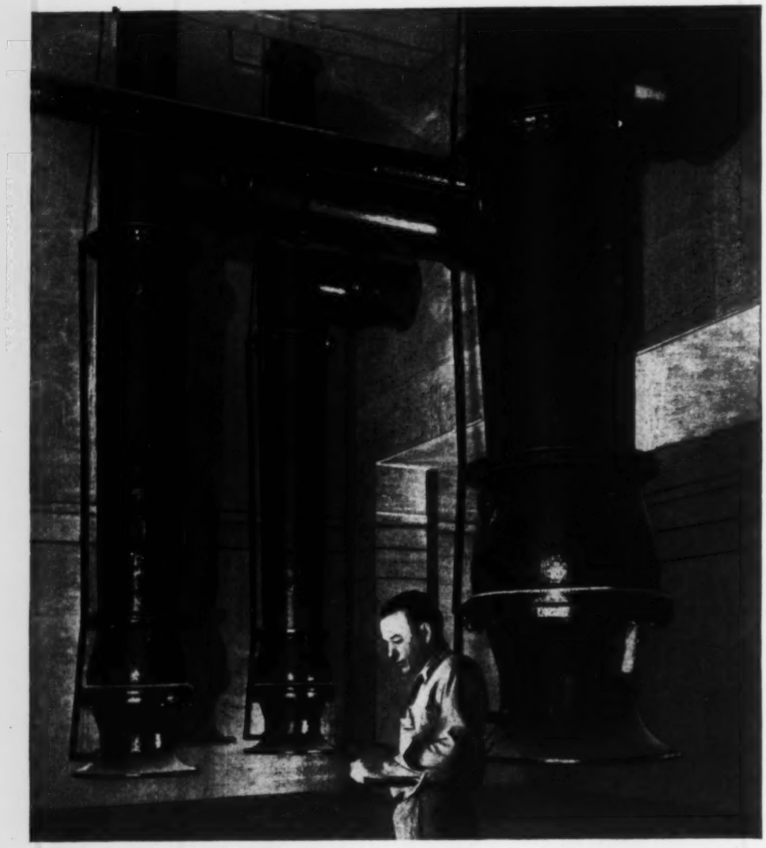
27 BUILDING CONSTRUCTION HANDBOOK

McGraw-Hill Book Co., Inc—Free descriptive literature on this 850-page handbook on modern building design and construction methods and data is now available. Written by Fred Merritt, it covers building materials; stresses in structures; soil mechanics and foundations; concrete, structural steel, and other constructions; roofs; acoustics; insulation; air conditioning; plumbing; costs; construction management; and specifications.

28 CAMERA-PROJECTOR

Keuffel & Esser Company—The new Micro-Master 105/35mm Camera-Projector is described in a new bulletin. According to the catalog, the instrument is the only camera-projector to utilize both 35- and 105-mm film. The 4-page brochure entitled "Big News in Miniaturization", outlines the exclusive features and specifications which make this unit the first camera-projector to combine the superior line quality of 105-mm film with the economies of 35-mm film, the catalog says.

DID YOU MAKE YOUR CHECKS PAYABLE TO THE PROPER COMPANIES? ARE THE AMOUNTS CORRECT?



the bigger your pumping problems...the better your reasons for giving them to WHEELER-ECONOMY

The U.S. Corps of Engineers had a tough flood control problem at its Jeffersonville, Ind. station. They solved it neatly with 40 Vertical Mixed Flow Pumps like the ones you see here. The largest are 36" Units which pump 23,000 gpm against a 32' head.

Wheeler-Economy Pumps of this type with capacities to 220,000 gpm and over are used for flood control, drainage and irrigation in hundreds of locations. C.H. Wheeler has *specialized* in the design and manufacture of high-capacity pumps for nearly 75 years. It has the facilities you need to solve your toughest pumping problem. Ask any Wheeler-Economy representative about them. Or write direct for complete information.

Economy Pump Division

C. H. WHEELER MFG. CO.

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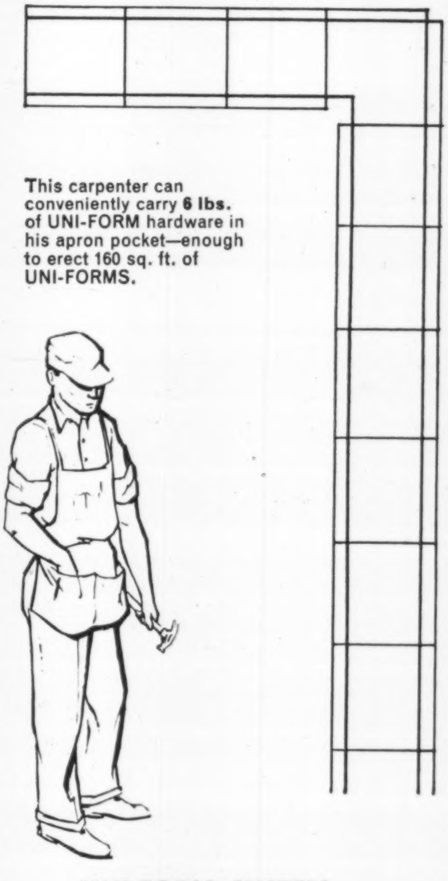
Whenever you see the name C.H.Wheeler on a product, you know it's a quality product

Centrifugal, Axial and Mixed Flow Pumps • Steam Condensers • Steam Jet Vacuum Equipment • Marine Auxiliary Machinery • Nuclear System Components

WHICH PREFAB FORM SYSTEM OFFERS MORE PRODUCTIVE FORMING TIME PER DAY?



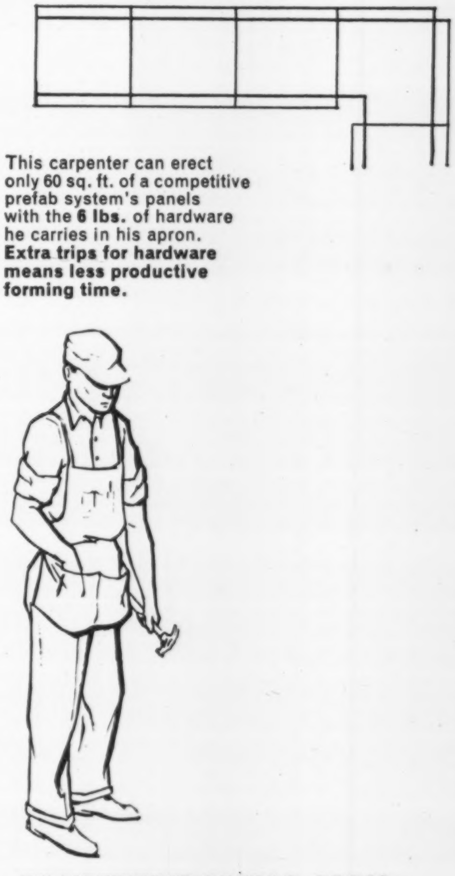
This carpenter can conveniently carry **6 lbs.** of UNI-FORM hardware in his apron pocket—enough to erect 160 sq. ft. of UNI-FORMS.

UNI-FORM SYSTEM

Carpenters can form more contact area per hour with UNI-FORM Panels than they can with any other prefab form system. The reason? It takes less hardware—in most cases, 50% less—to form a given contact area. And UNI-FORM hardware **weighs less, costs less,** and is easier to install.

EXAMPLE: **6 lbs. of UNI-FORM hardware—128 Tie Keys—are required to install 32 UNI-FORM Ties (4 keys per tie).** 32 Ties are required to erect 160 sq. ft. of UNI-FORM Panels.

Cost of hardware required to install 1 UNI-FORM Tie: **LESS THAN 4¢.**
(Tie Keys are re-usable)



This carpenter can erect only 60 sq. ft. of a competitive prefab system's panels with the **6 lbs.** of hardware he carries in his apron. **Extra trips for hardware means less productive forming time.**

COMPETITIVE PREFAB FORM

A leading competitive prefab form system requires 2 tightening wedges and 2 connecting bolts per tie installed. **In 6 lbs. of this hardware, there are only 24 sets of wedges and bolts—enough for 12 ties.** 12 ties will assemble **only 60** sq. ft. of this system's panels.

Cost of hardware required to install 1 competitive tie: **36¢.**
(Wedges and Bolts are re-usable)

WHICH PREFAB FORM SYSTEM GIVES YOU FASTER FORM ERECTION AND LOWER COSTS? Want more information about UNI-FORM Panels and the advantages they can bring to your concrete forming? Write today for complete details.

"Products from the Gold Toolroom"

UNIVERSAL FORM CLAMP CO. 1238 N. KOSTNER AVENUE · CHICAGO 51, ILLINOIS

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ATLANTA BALTIMORE CLEVELAND HOUSTON
LOS ANGELES SAN LEANDRO TORONTO

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MARACONCRETE *...

FOR HIGHER STRENGTH . .
GREATER DURABILITY, MINIMUM SHRINKAGE
AND LOWER CONCRETE COSTS.

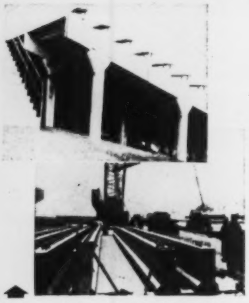
*** MARACONCRETE**
CONTAINS
MARACON®
WATER-REDUCING
ADMIXTURES FOR CONCRETE

California Bank Office Building, Los Angeles, California

Union Pacific Freight Station, Los Angeles, California

Standard Federal Savings and Loan Office Building Addition, Los Angeles, California

Concrete Pipe Manufactured by F. Hurlbut Co., Green Bay, Wisconsin



Everest High School Stadium Schofield, Wisconsin

Reinforced Concrete Beams Manufactured by F. Hurlbut Co., Green Bay, Wisconsin.

Maraconcrete is being used in the construction of reservoirs, bridges, runways and buildings . . . in the manufacture of reinforced concrete beams and pre-cast structures, in pipe and drain tile.

Use the coupon to learn how the addition of Maracon will enable you to get better concrete at lower cost.

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TITLE
COMPANY
ADDRESS

V-40

CATALOG DIGESTS

29 CAM-LOK FORMS

The Heltzel Steel Form and Iron Co.—Six-page Bulletin #59-3 graphically illustrates and describes the new cam-locking principle of Highway and Airport Forms. Detailed illustrations show how quarter turn of cam locks and aligns forms as compared with the old method of sledging lock into place. Tables give complete range of sizes and dimensions. Optional equipment is illustrated as described.

30 CARPULLERS

Superior-Lidgerwood-Mundy Corp.—A 24-page, 2-color bulletin C-616 "Carpullers for Easy Moving Rolling Loads" is available, with descriptions, illustrations, data, tables, and specifications for Carpuller requirements. Illustrates and describes the Electric Capstan Carpuller for car moving, barge moving, pipe bending or any haulage of similar nature; also Tugmore Capstans, Horizontal Head type Capstan Carpullers, Drum Type Carpullers, Friction Drum Type Carpullers, etc.

31 CAST IRON PIPE

U. S. Pipe & Foundy Co.—An 8-page booklet on centrifugally cast, Tyton Joint pipe for water or other liquids. The newly developed Tyton Joint is simple, study, and tight. Illustrations show details of joint and method of assembly.

32 CAST IRON PIPE, HYDRANTS AND VALVES

R. D. Wood Company—A general catalog is available providing full details of weights and dimensions of "sand spun" cast iron pipe and cast iron fittings. This catalog also features fire hydrants, gate valves, and other products manufactured by this company.

33 CATIONIC BITUMULS

American Bitumuls & Asphalt Company—After extensive testing, the company is now offering an entire line of Cationic Emulsified Asphalts. The booklet covers every phase of application, from surface treatments to mixing operations. Of all developments in the paving field, this appears to have most promise because it permits re-activation of old, by-passed aggregate sources and less concern for early rain.

34 CEMENT LININGS

Centriline Corporation—The Centriline Process for cement mortar lining steel, cast iron, concrete and terra cotta pipelines in place and which has been available in the diameters 16 in. to 144 in. can now be use in pipelines as small as 4 in. in diameter. This new adaptation of the Centriline Process for small pipelines eliminates the necessity for excavations at laterals and corporation cocks and is fully described in the new illustrated catalog.

35 CIVIL ENGINEERS' BOOK CLUB BULLETIN

McGraw-Hill Book Co., Inc.—The official guide reporting new books of professional interest and recommending various publications worthy of bookshelf space in the civil engineer's library is available. A single issue is free.

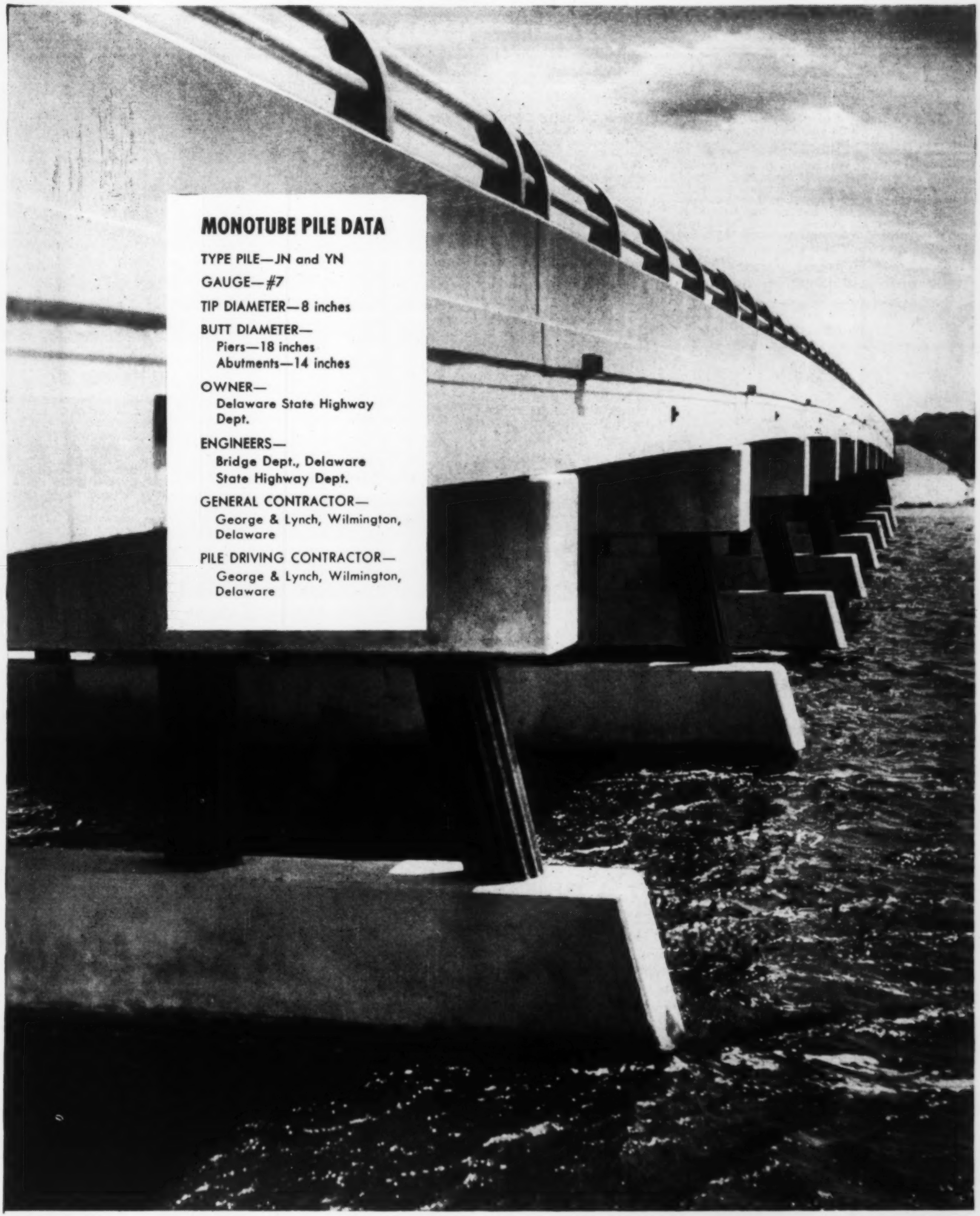
36 CLAD STEEL BRIDGE BEARING PLATES

Lukens Steel Company—This catalog contains a discussion of the development of the company's clad steel for bridge bearing plate applications together with a description of types of plates presently available.

37 COFFERDAMS

Spencer, White & Prentis, Inc.—"Cofferdams," by Lazarus White and Edmund Astley Prentis is a trusted source-book covering actual design and construction of cofferdams as well as the theoretical features. The price is $10.

N. B. There is a charge for this book. Make checks payable to Spencer, White & Prentis, Inc.



MONOTUBE PILE DATA

TYPE PILE—JN and YN

GAUGE—#7

TIP DIAMETER—8 inches

BUTT DIAMETER—
  Piers—18 inches
  Abutments—14 inches

OWNER—
  Delaware State Highway Dept.

ENGINEERS—
  Bridge Dept., Delaware State Highway Dept.

GENERAL CONTRACTOR—
  George & Lynch, Wilmington, Delaware

PILE DRIVING CONTRACTOR—
  George & Lynch, Wilmington, Delaware

DESIGN ECONOMY AND CONFIDENCE with Monotube Piles . . . acting both as piers and foundations for this prestressed concrete beam bridge at Fenwick Island, Delaware. The high columnar strength of Monotubes makes their application ideal for this type of project.

Tapered, fluted Monotube steel piles are available in lengths, diameters and gauges to meet your requirements. The Union Metal Manufacturing Co., Canton 5, Ohio—Brampton, Ontario, Canada.

UNION METAL

Monotube Foundation Piles

CATALOG DIGESTS

38 COMPACTION METHODS BOOKLET

The Galion Iron Works & Mfg. Co.—Booklet No. SR-31, an informative, well-illustrated, non-technical, 16-page pamphlet covering all types of rollers and other compaction equipment has been published. This treatise will be especially helpful to anyone who has previously had no opportunity to study the subject of soils and materials compaction, the problems encountered, and the application of the various types of equipment available.

Please give your complete address.

39 COMPOSITE CONSTRUCTION

Nelson Stud Welding Div., Gregory Industries, Inc.—The 4-page "The Case for Composite Construction" lists advantages of composite steel-concrete construction for both bridges and buildings. It illustrates both typical savings in steel and shop and field installation of cost-saving Nelson Stud Shear Connectors which are widely used in composite bridge and building construction.

40 CONCRETE AND MASONRY PRODUCTS

Tretol Inc.—Some of the concrete and masonry products described in this booklet are: Fluat, a liquid chemical hardener to dustproof, wearproof floors for protection against oils, alkalis and salts; Tretoscreed, a latex cement for resurfacing and repairing concrete floors and surfaces; Tretop, an armored metallic topping for hardening and coloring concrete floors; Actionate, a multi purpose liquid admixture to facilitate winter concreting, accelerate set, densify and plasticise concrete, mortar and stucco; and Tretocalk, a calking material for calking, sealing, pointing and glazing.

41 CONCRETE FORMING

Universal Form Clamp Co.—A 16-page booklet on items of interest to contractors and engineers on concrete forming is available without charge.

42 CONCRETE FORMING SYSTEM

Economy Forms Corporation—A catalog with pictures is offered showing a complete forming system available to contractors on a purchase basis. The easy adaptability of these forms to all types of form work, plus engineering layout service on each new project, together with a complete steel form good for a lifetime of service makes the EFCO form an attractive investment for the large and small builder. Also available, a four-page leaflet covering forms for prestressed or precast concrete beams, etc.

43 CONCRETE PIPE COUPLING—AMBAND

American-Marietta Company—A pamphlet on Amband fiber glass reinforced resin couplings used with double spigot, rubber gasketed concrete pipe. To be used for pressure heads up to 125 feet, for infiltration as low as 100 inch-gallons per mile per day. Amband couplings withstand corrosive action.

44 CONCRETE PLACING EQUIPMENT

True Gun-All Equipment Corporation—A brochure is offered on True Gun-All, the wet Mix Process for mixing and pneumatically placing low slump, quality controlled concrete. Truecrete, the trade name of concrete placed by True Gun-All equipment, requires only a single light form to achieve any desired design or shape. Photographs contained in the bulletin show some of the designs achieved with True Gun-All.

Turn to page 138 and order your literature.

45 CONCRETE SHORING EQUIPMENT

Rex-Spanall, Inc.—Some of the concrete shoring equipment included in this pamphlet are: 730 horizontal shoring for spans 7 to 30 ft. used for concrete formwork on industrial, commercial, institutional and heavy construction; 46 horizontal shoring for spans of 4 ft 2 in. to 6 ft 11 in., used for bridge construction and all types of minimum span concrete formwork; tripod shoring, easily assembled for support of heavy framework and to heights beyond the capacity of normal vertical shoring; high carrying capacity, self-cleaning, light weight and "precision" height adjustment.

46 CONCRETE TESTING EQUIPMENT

Forney's Inc. Tester Div.—A catalog is offered describing a complete line of plant and jobsite testing machines for cylinders, cubes, beams, blocks, pipe and tile. Capacities range from 0 to 250,000 lb to 0 to 500,000 lb. Also described is a complete line of collateral equipment including the Los Angeles Abrasion Machine, cube and beam molds, slump cones, and cylinder capping apparatus.

47 CONCRETE TO CONCRETE BONDING

Thiokol Chemical Corp.—Some of the subjects discused in this brochure are: What is Liquid Polymer?; Concrete Adhesives; Overlays; Remedial Patching; and Anti-Skid Surfacing. The booklet is illustrated. Also available is a booklet entitled "Liquid Polymers LP-2 and LP-32."

REFRESHINGLY NEW...

FLEX-TEE* A PRESTRESSED, SINGLE STEM, PITCHED ROOF DECK†

Here is the new roof member that fulfills *both* architectural and structural requirements for commercial, industrial and residential structures, schools and churches.

Backed by a carefully engineered and thoroughly tested design, here are some of the features which explain the growing acceptance of FLEX-TEES for use on many structures—Pleasing appearance of the 1 : 12 roof pitch; choice of any span (clear) between 24′ and 52′-8″ in 6′ width; optional overhang with flat cantilevered soffit; elimination of filler blocks at ends; simplified bearing wall construction; anchor dowel connections to walls requiring no welding; uniform camber allowing immediate and rapid application of insulation and roofing material; reduced erection time because of rapid closure of buildings; suitability of underside for handsome exposed beam or hung ceiling treatment.

The simplicity of manufacturing FLEX-TEES in a production yard or at the jobsite adds to the economy and flexibility of this roof deck.

For complete details, write for new brochure.

Manufacture of FLEX-TEES authorized under franchise.

PRESTRESSED CONCRETE INSTITUTE
MEMBER

FLEXFORMS, INC.
Affiliated with The Prescon Corp.
1445 West Quincy
Englewood, Colorado

*TRADEMARK
†PATENTS APPLIED FOR

CATALOG DIGESTS

48 CONCRETE WATERSTOPS

Water Seals, Inc—Labyrinth^R Waterstops are manufactured of polyvinyl plastic, which helps maintain a constant, strong, watertight bond between concrete joints. A catalog describes the convenient features of Labyrinth^R Waterstops, including those which render it resistant to age, chemical and weathering changes. Blueprint type specification drawings include the Labyrinth, Flextrip, Cellular and Dumbbell waterstops in their various sizes. A table lists the recommended joint application and water head for each size and kind of waterstop.

49 CONSOLIDATED TESTING APPARATUS

Soiltest, Inc.—A 4-page bulletin is available on consolidation test apparatus. Illustrated and described is the Soiltest Levermatic Consolidation Device, which loads up to 20 tons on a 2½ in. dia specimen. Other frame mounted lever loading consolidation units are also shown.

50 CONSTRUCTION EQUIPMENT

Caterpillar Tractor Company—Brief specifications for track-type tractors, scrapers, motor graders, Traxcavators, Bulldozers, rippers, pipelayers, cable and hydraulic controls, wheel tractors and diesel engines are contained in a 20-page booklet, "Caterpillar Construction Equipment." Also included in Booklet No. 33659, are descriptions of attachments and tools manufactured by auxiliary equipment manufacturers and available through the company's dealerships.

51 COPYFLEX DIAZOTYPE COPYING PROCESS

Charles Bruning Co., Inc.—A 12-page illustrated booklet describing the Copyflex diazotype copying process is available. This booklet describes the concept of the process as related to simplification of paperwork in business operations. The method of using reproducible copies, removing information from originals and copies, combining Polaroid Land Photos and text to produce illustrated copies, are just a few of the techniques illustrated and described step by step in the booklet.

52 COPYFLEX DIAZOTYPE REPRODUCTION PROCESS

Charles Bruning Co., Inc.—A 12-page illustrated booklet describing the Copyflex diazotype reproduction process is now available. The booklet explains the various types of direct-positive prints possible with Copyflex, including black-line or color-line prints on white or tinted stock; multi-color films for projection and overlays; translucent duplicate originals; dimensionally stable film and glass cloth prints; and reflex prints on translucent film.

53 CRAWLER TRACTOR—103

The Eimco Corporation—A 28-page booklet on the 103 line of crawler-tractors is now offered. The 103 is available as a tractor, in twelve models of bulldozers, front end loader, log loader and a special steel mill front end loader. Bulletin L-1097 contains full specifications on various models, descriptions, highlights and engineering facts of the many new and exclusive features incorporated into this maneuverable and rugged tractor line.

54 CRAWLER-TRACTOR—106

The Eimco Corporation—A new booklet, No. L-1116, contains specifications, pictures and highlights of features of the 106 crawler-tractor and bulldozers. The 106 incorporates such features as "Unidrive" transmission, Dual Final Drives, Single Stage Torque Converter, up-front operator position and many others, as standard equipment.

55 CURVE CROWN PULLEY

Stephens-Adamson Mfg. Co.—The availability of Bulletin 558 on the new Curve Crown welded, all steel Pulley has been announced. The literature features comprehensive technical and engineering data, specifications, diagrams and illustrations.

56 CYLINDRICAL WOOD TANKS

Fluor Products Company—A 24-page booklet is available on cylindrical wood tanks. Some of the subjects included in this brochure are specifications for cylindrical tanks, standard tank lugs, tank foundations, tank covers, and directions for erecting wood tanks.

57 DENSION CORE BARREL

Acker Drill Co., Inc.—offers free of charge, a copy of Bulletin 1100, which describes the Dension Core Barrel. Acker has obtained exclusive manufacturing rights to the tool. The brochure illustrates and describes how the core barrel operates. The cutaway drawing of the barrel shows all of the important operational features.

58 DESIGN MANUAL

W. R. Meadows, Inc.—has prepared a manual entitled "Design Techniques for Controlling Moisture in Building Structures." This manual, prepared by a firm of technical engineering writers, was originally planned to sell for $1.00 per copy. However, as this problem is of vital interest to all in the construction industry, this company will now send a free copy to all architects, engineers and builders who desire a copy for their file.

Return the coupon today!

We Invite AWWA *Delegates To*

STOP by ANNISTON

On your way to or from the AWWA convention May 15-20 in Bal Harbour, Florida (Miami Beach) stop at Anniston, Alabama, and visit with us. We cordially invite you to see our enlarged manufacturing facilities, break your trip for a few hours or a day and be our guests.

You'll find it time well spent to see first hand just how the high quality of M & H products is attained in our modern plant. Either stop by unannounced, or "if you let us know you're coming we will bake a cake!"

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LOUISVILLE
NASHVILLE
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MEMPHIS
CHATTANOOGA
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BIRMINGHAM
ATLANTA
DALLAS
NEW ORLEANS
FLORIDA

M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

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CATALOG DIGESTS

59 DIAMOND BIT AND CORE BARREL

Acker Drill Company, Inc.—Bulletin 10 describes and illustrates the company's complete line of diamond bits and core barrels. The core barrel illustrations are shown as cut-aways to facilitate the reader's interpretation of construction and drilling.

60 DIESEL TRACTOR SHOVEL

Allis-Chalmers Mfg. Co., Tractor Group—An 8-page revised catalog covering the 2¼-yd capacity HD-11G diesel tractor shovel is available. Illustrations help explain the unit's engineering, design and construction features.

61 DIGESTER CIRCULATING-MIXING EQUIPMENT

Walker Process Equipment Inc.—The Gaslifter is an exclusive development for circulating and mixing digester contents. Grease and scum blankets and bottom deposits are eliminated resulting in increased digester efficiency and capacity. The Gaslifter utilizes digester gas, through the air lift principle to effect the circulation action. Bulletin 25-S-91 furnishes details and photos of installations.

62 DIGESTER SLUDGE HEATING EQUIPMENT

Walker Process Equipment Inc.—The Heatx for digester sludge heating is presented in Bulletin 24-S-82. Designed specifically for sludge heating the Heatx features a custom burner and heat exchanger combined with a separate boiler to furnish the most efficient system available. The units operate on digester gas with automatic switchover to either natural gas or oil for auxiliary fuel. Capacities range from 110,000 to one million btu/hr.

63 d/M GAUGE

Nuclear-Chicago Corporation—Described and illustrated in an 8-page catalog is the d/M-Gauge, a new, modern instrument for rapid, precise field measurement of moisture content and density. Consisting of a simple counting unit (scaler) and either a moisture probe or a density probe, it may be used on a wide variety of cohesionless, viscous, liquid and solid materials. A single relatively inexperienced operator with little or no technical training can successfully use this completely portable system to obtain precision "on the spot" moisture or density determinations in less than 1/10th the time required by other methods.

Please give your complete address.

64 DOUBLE-SEALING FASTITE JOINTS

American Cast Iron Pipe Company—This illustrated 12-page brochure describes the advantages of the double-sealing, single gasket Fastite Joint. It contains instructions for assembly, weights and dimensions, and typical installations of American Fastite pipe for water, sewage and other liquid service.

65 DRAIN GRATES

Irving Subway Grating Co., Inc.—A four-page, two-color folder illustrating the use of open mesh steel flooring as drain grates is available. The folder contains photographic illustrations and shows typical uses of drain grates. There are engineering drawings of the various types and complete technical data to facilitate estimates and specifications.

66 DREDGING EQUIPMENT

Posey Iron Works, Inc.—This catalog contains photographs of drag heads, combination wye branch and gate valve, fabricated spuds, pontoon and shore pipe, pressed steel plate ball joints with abrasion resisting steel plate liners, and hydraulic dredge hull. The company offers a complete selection of pipe and other dredge fittings to meet every dredging need. All units that are subject to abrasion are fabricated from high carbon—high manganese special dredge pipe steel or abrasion resisting steel.

67 "DU-O-JECT" PNEUMATIC EJECTOR LIFT STATION

Smith & Loveless—A new 6-page bulletin on the factory-built "Du-O-Ject" pneumatic ejector sewage lift station is offered. This duplex unit features two compressors, dual piping and two receivers for stand-by dependability. It is available in complete engineering data manual on sewage lift stations with specifications and design notes.

68 EJECTOR STATIONS

Zimmer & Francescon—The time proven pneumatic sewage ejector systems are now made available in a brand new complete station package. The pretested units include all components preassembled in a steel structure ready for direct burial, and are used wherever it is necessary to raise sewage at capacities below the practical limit of nonclog pumps. Applications include sub-divisions, motels, resort areas, schools, municipalities and sanitary districts.

69 ELECTRONIC COMPUTING SYSTEM

Royal McBee Corporation, Data Processing Div.—Complete specifications on the new RPC-4000 electronic computing system are given in a catalog sheet, S-482. The RPC-4000 is fully transistorized, electronic, stored program, general purpose computing system, for both engineering and business data processing. The basic system consists of the computer and a punched paper type typewriter input-output unit.

70 ELEVATED TANKS

Pittsburgh-Des Moines Steel Co.—Details of the several different types of elevated steel tanks, including capacity, ranges, tank dimensions, and other factors to be considered in the selection of storage tanks. Also available, 4 pages of pictures and discussion about flat bottom water storage.

71 ELEVATED WATER STORAGE TANK

Graver Tank & Mfg. Co.—A handsome booklet in full color describing a new design for elevated water storage tanks is offered. Besides its operational features, the Aquatore has a wholly new and distinctive appearance, according to the manufacturer. Suited to capacities from 300,000 gal to 3 million, it is the first advance in elevated tank design in nearly a quarter century, the company states.

72 ELLIPTICAL CONCRETE PIPE—LO-HED

American-Marietta Co.—This pamphlet covers elliptical Lo-Hed Reinforced Concrete Pipe for culverts and sewers. Specifications are given for the complete range of sizes from the equivalents of round pipe 18-in. I. D. through 144-in. I. D. Illustrations show results of pressure tests and installations of Lo-Hed pipe being made on various types of jobs.

73 ENGINEERING BOOKS

The Ronald Press Co.—A revised brochure on 29 up-to-date, authoritative books is offered. Of prime interest to civil engineers are books covering such subjects as: power plant theory and design, air conditioning, soils engineering, substructure analysis and design in metals, linear structural analysis and statically indeterminate structures.

How to handle WET JOBS #53 of a series

1950 Project: Sewage Plant, Rockaway, N.Y.

Contractor: Merritt-Chapman & Scott Corp.

1960 Project: Plant addition.

Contractor: D. Fortunato, Incorporated.

Unusual features marked 2 predrainage operations at this site. In 1950, an unbraced cofferdam was maintained 30′ below bay. In 1960, wellpoints were tunneled under structures as plant kept working. Both jobs successful — both by Griffin.

GRIFFIN WELLPOINT CORP.

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Hammond • Houston • Jacksonville • West Palm Beach

25th YEAR

In Canada: Construction Equipment Co., Ltd. • In Venezuela: Drew Bear & Sons C. A.

CATALOG DIGESTS

74 ENGINEERING BOOKS

John Wiley & Sons, Inc.—The 1960 Catalog of Wiley Engineering books is offered, listing titles in Engineering Sciences, Civil Engineering, Architecture, Mathematics, Statistics, and Operations Research, as well as a complete listing of Methuen's Monographs on Physical Subjects. Individual subject catalogs are also available for Science and the Social Sciences.

75 EPOXY RESIN ADHESIVES

Thiokol Chemical Corp.—This 14-page technical bulletin includes a general discussion of Epoxy Resin Adhesives; a summary of results; methods of testing; application costs of Liquid Polymer/Epoxy Concrete Adhesives; and application and working properties. Charts of curves showing time/temperature curing characteristics of LP/Epoxy Concrete System are also included.

76 EXPANSION PLATES & BUSHINGS

Lubrite Div., Merriman Bros., Inc.—Manual No. 55 contains complete information, technical data, and specifications about Lubrite self-lubricating expansion plates and bushings for bridges, buildings, refinery equipment, chemical processing equipment high temperature, missile and atomic applications. Lubrite plates or bushings are completely self-lubricating and do not require periodic maintenance or servicing. Ideal where ordinary lubrication is objectionable, neglected, expensive to maintain or for inaccessible plates or bushings.

77 EXTRUDED CEMENT MORTAR COATING

Pipe Linings—A coating process for pipe, in diameters from 4 inches through 12 inches has been developed, which is not only superior to existing methods such as guniting or brush coating, but is also lower in cost. The cement mortar is extruded in a manner which provides a smooth, dense, uniform coating; and the bond has proven to be excellent. The process eliminates any waste of materials and increases the speed of production with conformation on a troweling device to provide a smoother-than-ever cement mortar lining with consequent improved flow characteristics in 12-in. dia pipe and larger. The company will soon have a Spunline troweling device for pipe down to 8 in. in diameter.

78 FABRICATED PIPE & PILING STEEL

Posey Iron Works, Inc.—This 15-page catalog contains in-ship and field installation photographs, which are typical of the wide variety of jobs fabricated by the company. A few of the illustrations included are: car of pipe leaving plant, driving 30-in. OD Piles for bridge piers, special steel fabrication for oil refinery, and special fitting of stainless steel.

79 FENDER BUFFERS

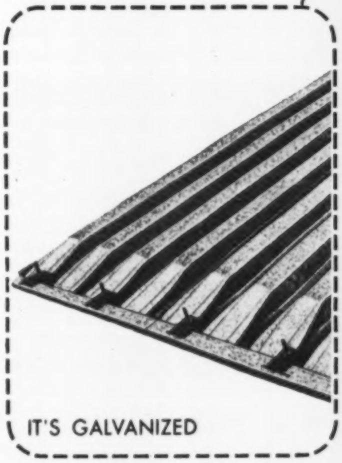
The General Tire & Rubber Co.—A 6-page folder is available on Raykin Fender Buffers, an easy to install and inexpensive to maintain dock fendering system. Consisting of V-type arrangements of special rubber slabs bonded to tough steel plates, the buffers can be supplied, tailor-made, with deflection from 3 in. to 24 in. and energy absorption from 5,000 to 139,000 ft-lb. Unaffected by corrosion, rotting or aging, they give positive, all-angle protection for harbor installation.

In filling out the coupon, please print clearly and be sure that you furnish a complete address.

80 FIBRE FORMS

Sonoco Products Co.—Uses of Sonotube fibre forms, are illustrated in a brochure. These fibre forms provide an economical method of forming round, obround, half-round and quarter-round columns. Also encasement of steel and wooden piles, existing columns and utility risers. Available in several different types, the newest which provides a form surface requiring little or no rubbing of the finished column. Technical data also available.

Answers time-saving, labor-saving problems...?



USF

"leave-in-place"
STEEL FORMS
FOR CONCRETE BRIDGE DECKS

eliminates material waste, time schedule delays, removal expense and hazardous operations. Send for free details on this modern construction method.

USF

Highway Guard Rail
Bridge Flooring
Steel Forms for Concrete Bridge Decks
Corrugated Metal Pipe
Window Wells
Metal Doors & Frames
Metal Buildings

United Steel Fabricators, Inc. Wooster, Ohio

CATALOG DIGESTS

81 FIBRE TUBES

Sonoco Products Co.—Sonovoid fibre tubes were specifically developed to form voids in bridge decks; wall, floor, roof and lift slabs and in concrete piles. Uses illustrated in a brochure. Sonovoid fibre tubes are used in precast or cast-in-place units of conventional or pretensioned construction. Tie down and spacer method shown along with design data for 8-in. and 12-in. slabs. Other technical data available.

82 FIELD EQUIPMENT

Warren-Knight Co.—The Warren-Knight Catalogue, Part I, of Engineering Field Equipment (24 pages) has been revised and reprinted and is now available. This book includes photographs and descriptions of standard field equipment and supplies including Builder's Instruments, Compasses, Measuring Tapes, and practically everything needed for the Engineer and Builder for Field use. Paragraphs pertaining to instrument care and repair are included. Part II with a complete description of drafting equipment and supplies (48 pages) including everything needed for the drafting room is also available for free distribution.

83 FILTER MEDIA

Anthracite Equipment Corp.—A bulletin on "Anthrafilt" tells the reasons why selected, graded crushed anthracite is superior to sand as a filtering material. Information about a free technical advisory service is included.

84 FIREPROOF COLUMNS

Tubular Products, Inc.—This catalog covers the new concrete filled, double shell, fire resistant columns, which are approved by Underwriters' Laboratories, Inc. Specifications and cross-section sketches are provided of round, square and rectangular tube columns, in addition to comprehensive design details for incorporation in drawings and specifications.

85 FORTY FIVE MOTOR GRADER

Allis-Chalmers Mfg. Co., Tractor Group—A 16-page revised illustrated catalog on the Forty Five motor grader features the grader's 127-hp diesel engine, power train and special equipment; specifications are included.

86 FOUNDATION CAISSONS AND PILES

Franki Foundation Company—An interesting, informative and well-illustrated brochure describes in detail the Franki method of installing Displacement Caissons and Pressure Injected Footings. Caisson load test results on representative projects and reinforced concrete cap design data are noted.

87 FOUNDATION PRESTRESSING

Stressteel Corporation—This catalog describes the application of prestressing to concrete arch construction underway at the new Passenger Terminal Building, Idlewild Airport, New York. The large thin shell roof rests on four massive piers which are tied, one to the other, by prestressed concrete tension ties which take the horizontal thrust. The method of placing the high strength bars and post-tensioning them is shown in detail.

88 FRAMELESS METAL BUILDINGS

Behlen Manufacturing Company—This 28-page catalog contains information about frameless metal buildings. The brochure states that the roof and side walls are heavy gauge, channel-ridged metal that forms permanent, sturdy, rigid frame arches. The buildings are adaptable to a wide range of installations; each one is custom-made to fit your specifications. They can be erected in days, using semi-skilled labor.

89 FRONT END LOADER

The Eimco Corporation—Features, specifications and user-results are outlined in Bulletin L-1092 just issued on the powerful 205-hp 126 Front End Loader, claimed to be the most powerful unit of its type on the market today. Pictures, engineering features and specifications show it in use and illustrate its many exclusive advantages.

90 GATE VALVES, AWWA, CLASS C

M & H Valve and Fittings Co.—Bulletin No. 14 illustrates and describes AWWA standard double-disc valves in sizes 2-in. to 42-in., inclusive, operated manually, hydraulically or by electric motor.

91 GEAR DRIVE

Johnson Gear & Mfg. Co.—Right angle gear drives for vertical shaft pumps and industrial use such as sewage disposal, water supply, fire and flood control, cooling tower installations and barge service, are described and illustrated in Bulletins #31 and #32. Many new features have been added including the Redi-Torque drive for automatic installation.

92 GEARS

The Earle Gear and Machinery Company—A twenty-page catalog describes in general, the kinds and sizes of gears manufactured by this company. Its contents deal with spur gears, bevel gears, helical gears, worm gears, racks, non-metallic gears, sheaves, sprockets, special machinery of which gears form a part, and special gear information. Illustrated with photographs, it also shows actual Earle installations.

93 GKO LEVEL WITH ERECTING EYEPIECE

Kern Instrument Inc.—This new model in the famous Kern Surveying Instrument line was especially designed for the U.S. market. In addition to the Erecting Eyepiece, the instrument is easier and more comfortable to operate and may be used on a Theodolite Tripod with an adapter plate.

94 GRATING FLOORING AND TREADS

Irving Subway Grating Co., Inc.—General Grating Catalog F400 contains illustrations, descriptions and complete engineering data on full line of grating products made in steel, aluminum and other metals. Catalog shows riveted, welded and pressure-locked types for use as flooring, treads, walkways, trench covers, and so on. Irving grating is safe, durable, self-draining, ventilating, clean, fireproof, economical.

95 GRATINGS

Borden Metal Products Co.—A 16-page catalog shows the three basic types of grating construction; more than 30 dimensional drawings of subtypes; eight safeload tables covering steel and aluminum gratings, roadway grating and sidewalk slabs plus other tables on panel widths, tread widths, floor armor, etc. Also shown are the various safety treads and their nosings. Included are the steps for careful planning and checking of the job.

96 GRAVITY SEWER PIPE

Keasbey & Mattison Co.—Asbestos-cement gravity sewer pipe, designed for economical, long life non-pressure sewer systems, is described in a 4-page folder, AP-22. Profusely illustrated, it points up savings in design, installation and operation with asbestos-cement pipe. Complete dimensions, tolerances as well as other specifications needed by the engineer are included.

97 GROUT, CHEMICAL

American Cyanamid Company—This 25-page booklet contains information about AM-9 Chemical Grout, a product that represents a new concept in the fields of soil stabilization and grouting. Typical applications and illustrations are included.

DISCERNING
DRAFTSMEN
THE WORLD OVER
DEMAND IMPERIAL
THE WORLD'S FINEST
TRACING CLOTH

1506

CATALOG DIGESTS

98 GROUTED AND NON-BONDING TENDONS

The Prescon Corporation—A new folder describes the use of the company's grouted and also non-bonding tendons as used in the construction of tanks and reservoirs. Illustrations show two examples, as well as forming framework, anchoring tendons, and tendons as delivered to jobsite. Tendon requirements for the Harlan A. Gate Reservoir, Pico-Rivera, Calif., are given.

99 GUYED AND SUSPENDED STRUCTURES

John A. Roebling's Sons Division The Colorado Fuel & Iron Corp.—This publication contains information required for selection and preparation of specifications for wire, strand and rope used on guyed structures and suspended systems of all kinds, except major suspension bridges. Both standard and special fittings for use with bridge strand and bridge rope are shown.

100 HANDBOOK OF HEAVY CONSTRUCTION

McGraw-Hill Book Co., Inc.—Free descriptive literature describes a convenient reference by Frank Stubbs Jr. It contains working information needed in all branches of heavy construction. This 1040-page book gives quick answers to questions on earthmoving, concrete, steel erection, highways and foundations.

101 HELICOPTERS

Hiller Aircraft Corporation—A series of illustrated folders describing the uses of helicopters in five primary industries served by civil engineers has recently been published. They also cover charter, lease and purchase plans for the 305-hp utility helicopter. The booklets are available on construction, forest management, petroleum, utilities and state and local government management.

102 HIGHWAY DESIGN PROGRAM FOR COMPUTER

Royal McBee Corporation, Data Processing Div.—LGP-30 Application Report #13, a six-page brochure describing a new complete highway design program for the Royal Precision LGP-30 electronic computer, has been released. This program determines the design of highway roadbeds, including slope decisions, superelevation adjustments, widening corrections, the addition of special ditches where required and the performance of earthwork calculations, including rock excavation in addition to straight cut and fill.

103 HIGHWAY ENGINEERING HANDBOOK

McGraw-Hill Book Co., Inc.—Free descriptive literature is available on this 1696-page handbook covering modern highway engineering from financing, planning, and traffic engineering to design, construction, maintenance, and landscaping. Edited by Kenneth B. Woods, it supplies a wealth of tested methods, working data, technical details, practical guidance, etc. Treats such topics as route selection and layout, basic highway design, soil mechanics, preventing slipperiness, rigid and flexible pavements, and much more.

104 HIGHWAY GUARD RAIL

United Steel Fabricators, Inc.—Specifications, installation and curving data are contained in a brochure on Universal-Beam Guard Rail. It is fabriacted in either 10 or 12 guage, and offers maximum protection, excellent visibility and high impact strength. Deep, wide, center corrugation serves as a bumper guide and helps bring vehicles under control. The wide lap joint assures high beam strength. Top and bottom edges are turned back for safety. Also available are two pamphlets on prefabricated all-steel hangars.

105 HOME SEWAGE EJECTOR

Smith & Loveless—A new bulletin on the factory-built "Uniject" pneumatic sewage ejector for single dwellings is offered. It is designed to raise sewage to a gravity sewer line, on-the-site treatment facility or septic tank. Capacity to 15 gpm at 20 ft tdh. Not a sump pump, it handles 3-in. solids.

ANOTHER PROBLEM
SOLVED BY
SPENCER,
WHITE &
PRENTIS

ALTERNATE BRACING, NO WALERS

Unique way to use timber sheeting for bank support and back form proves both practical and economical

Project: Military Park Underground Parking Garage, Newark, N. J.
General Contractor: Terminal Construction Corp., Wood-Ridge, N. J.
Consulting Engineers: Weiskopf & Pickworth, New York City
Architects and Engineers: Frank Grad & Sons, Newark, N. J.

In the above-pictured installation of horizontal wood sheeting, the braces are positioned at every second soldier beam. Ordinarily such alternate bracing would require walers; instead, this special design successfully substituted a system of tensioned struts and angles.

Without any encumbering walers, the sheeting served perfectly as a back form—after it had supported a trench (which was needed to relocate an existing sewer line) and had also maintained the street as the contractor excavated 36 ft. to subgrade for the main structure.

The special plan—by Spencer, White and Prentis—proved both practical and economical. Can we be of service to you?

CATALOG ON REQUEST

Spencer, White & Prentis INC.

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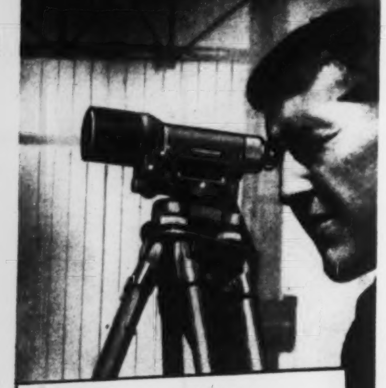
WHERE THERE'S A
BIG JOB
THERE IS A
KERN
INSTRUMENT



WORLD FAMOUS

precision surveying instruments... compact, rugged construction... fast, effortless operation. More reliable results in less time.

KERN'S NK3
precise level

Was used at Gloucester Anchorage of new Walt Whitman Bridge then under construction over Delaware River (Modjeski & Masters, Ammann & Whitney. Consultants to the Delaware Bridge Authority of Pa. and N. J.)

DESIGNED FOR HIGHEST PRECISION LEVELING

- **Functional, down-to-fundamentals design—only 4½ lbs. (8 lbs. with carrying case).**
- **Coincidence level and fine tilt screw.**
- **Readings at a glance—level and rod may be read simultaneously through 30x Telescope.**
- **Mean leveling accuracy under normal conditions ± .008 ft. per mile.**
- **Kern AR coated optics produce substantial increase in brilliance and contrast of image.**

Write for Brochure NK 527 -2

PROMPT, RELIABLE SERVICE
FACTORY TRAINED PERSONNEL

Kern and Only Kern Offers You the Latest Designs of Dr. Henry Wild

Kern SWISS
The FINEST in SURVEYING EQUIPMENT

KERN INSTRUMENTS INC.
120 Grand St., White Plains, N.Y.

CATALOG DIGESTS

106 HOW TO CORE DRILL

Acker Drill Co., Inc.—"Basic Procedures of Diamond and Shot Core Drilling" shows with over 80 illustrations and drawings the fundamentals of core drilling practice. Pipe driving, core recovery, core logging and storage are all covered in this pocket size book for the beginning driller. The price is $1.00.

N. B. There is a charge for this book. Make checks payable to Acker Drill Co., Inc.

107 HYDRAULIC TURBINES

The James Leffel & Co.—Details on turbines which drive both power generating and pumping units at the United States Bureau of Reclamation's Chandler Power and Pumping Plant are given in 12-page Bulletin 1098-E. Descriptive literature on other recent Leffel turbine installations will be enclosed.

108 HYDROLOGIC INSTRUMENTS AND ACCESSORIES

Leupold & Stevens Instruments, Inc.—A complete short form catalog of Stevens hydrologic instruments and accessories has been published. Included are descriptions and photographs of liquid flow recorders and indicators; liquid level recorders; telemetering systems; servo controls for recorders and transmitters; precipitation recorders and gages; and accessory equipment.

109 IMPROVEMENT OF WATER FACILITIES

Cast Iron Pipe Research Association—By writing on their business letterhead, engineers concerned with water utilities may have a copy of this association's book "Water—Make Sure You'll Always Have Plenty." Prepared to acquaint civic leaders with the seriousness of the community water problem, it gives a step-by-step outline of what citizens can do to help improve community water facilities by working with water utility executives.

110 INDUSTRIAL COOLING TOWERS

Fluor Products Company—A brochure is offered which discusses Counterflow Induced Draft Cooling Towers, an ideal balance between standardized construction and a tailor-made tower. They are completely prefabricated for speed and ease of erection and minimum cost. Component parts are fabricated in modules of 6 ft by 6 ft in the horizontal plane and 8 ft vertically.

111 IN-PLACE REINFORCED CEMENT MORTAR LINING

Pipe Linings—Information is available on rehabilitating old pipelines in place and adding strength to them to resist internal working pressures and external loadings. The company's specialists will place steel reinforcing rod in any pipeline 24 in. in dia or larger and embed it in a cement mortar lining. The maximum diameter of the spiral reinforcing rod for pipe sizes from 24 in. to 48 in. is ¼ in. Pipe over 48 in. I.D. may be reinforced with steel rod up to ⅜ in. dia. The spacing of the reinforcing rod may be varied from ½ the dia of the rod to a 3 in. maximum depending upon the strength requirements for the equivalent steel area.

112 INTERNAL VIBRATOR

Wacker Corporation—Literature has been published on the Internal Vibrator which has low voltage (50 volt); electric shock is now eliminated; no ground is necessary. It contains a hi-frequency single or double head—180 cycle. The long narrow head is ideal for vibrating around narrowly placed reinforcing rods.

113 INTRAPLAST

Sika Chemical Corporation—Information is offered on Intraplast grouting aid for use with portland cement to produce maximum penetration and controlled expansion before final hardening. Material is widely used for grouting of prestressed tendons and for solidifying deposits of aggregates above or below water.

TIDE GATES

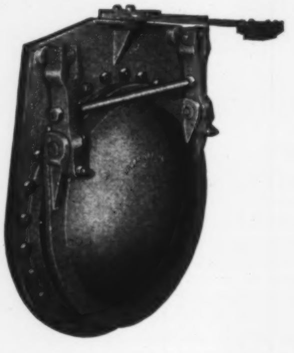


Figure B-175. Type M-R Gates designed especially for application to centrifugal pump discharge lines. A rubber seating ring is inserted in the seat to absorb the slap which occurs when pumps stop. A flexible bar connection is arranged between the hinge links to provide a stop for the gate shutter to prevent the outer edge of the shutter from tipping downwardly when flow abruptly ceases. Smaller sizes of gate are provided with a bumper arrangement to prevent the shutter being forced too widely open when flow starts.

Ask for Bulletin 73A

BROWN & BROWN, INC.
LIMA, OHIO, U. S. A.

New book tells
Where...
How...
to place reinforcing bars

Written for bar setters and inspectors ... as a manual for apprentice courses... and a reference for specification writers, architects, engineers, and detailers.

Contains complete specifications and instructions for placing reinforcing bars, welded wire fabric, and their supports.

CRSI
RECOMMENDED PRACTICE
FOR
PLACING REINFORCING BARS
1959
CRSI
Concrete Reinforcing Steel Institute

Prepared under the direction of the C.R.S.I. Committee on Engineering Practice.

287 PAGES
HANDY POCKET SIZE
$3.00
No C.O.D. orders accepted. Refund if returned within 10 days

Concrete Reinforcing Steel Institute
38 South Dearborn Street (Div. N)
Chicago 3, Illinois

CATALOG DIGESTS

114 JETTING PUMPS

Griffin Wellpoint Corporation—A booklet illustrates jetting pumps for pile and caisson jetting, oil pipe line testing, water supply and fire protection. The illustrations show unusual set-ups for high-pressure jetting, including parallel and series pumping arrangements.

115 JOINTED VITRIFIED CLAY PIPE

American Vitrified Products Company—A pamphlet is offered which discusses the Amvit Jointed Vitrified Clay Pipe which is manufactured from plasticized resins of polyvinyl chloride; no other combination of materials is used or needed. No special tools or equipment are needed and the line can be installed in the most severe weather. Also available is a catalog on Glas-Glaz, a glass lined sewer pipe which is acid resistant and rootproof.

116 KON-X BEARING PADS

Keasbey & Mattison Co.—A data page is offered describing bearing pads composed of asbestos fibers in combination with a synthetic rubber elastomer. They are ideal as pads under prestressed concrete beams placed over abutments. Resiliency is maintained despite extremes in temperature. The data page details other uses as well as physical parameters.

117 KWIK-SEAL WATERSTOP

The Gates Rubber Company Sales Div., Inc—This 24-page manual gives examples of many waterstop installations as well as a description of features and design. Tables, charts and illustrations supplement text on comparative data, types and sizes, physical characteristics, selection and application data. Also included is detailed information on installation, specifications, and engineering service.

118 LAND RECLAMATION

Ellicott Machine Corporation—This 12-page booklet describes the way enterprising businessmen are turning swamps and marshes into usable and valuable acreage. Two of the land reclamation ventures discussed are Key Colony Beach in the Florida Keys and Venezia, a 1,200 Home-site development near New Smyrna Beach, Florida. Key to the profit boom in land reclamation is the vast improvement in partability, versatility and economy of hydraulic dredges, which are designed to work with proved efficiency and economy, and feature compact hulls, shallow drafts, low superstructures, and can be operated by a minimum of three men.

119 LARGE FASTENERS

Jos. Dyson & Sons, Inc.—An informative 4-page bulletin, No. 160, has recently been published describing a complete range of large fasteners in bolt diameters 1¾ in. through 12 in. Large fasteners illustrated include a wide variety of standard and special forged nuts in the following types: hexagon, jam, square, slotted, recessed pin nuts and pins, pilots and driving nuts, hexagon and hex socket head cap nuts, coupling and sleeve nuts.

120 L-E-VATION ROD

Lenker Manufacturing Company—A brochure is offered on the L-E-Vation Rod. This is a new method of reading elevations. The Rod carries the elevation which is read direct. Working from a height of instrument and subtracting rod readings is entirely eliminated.

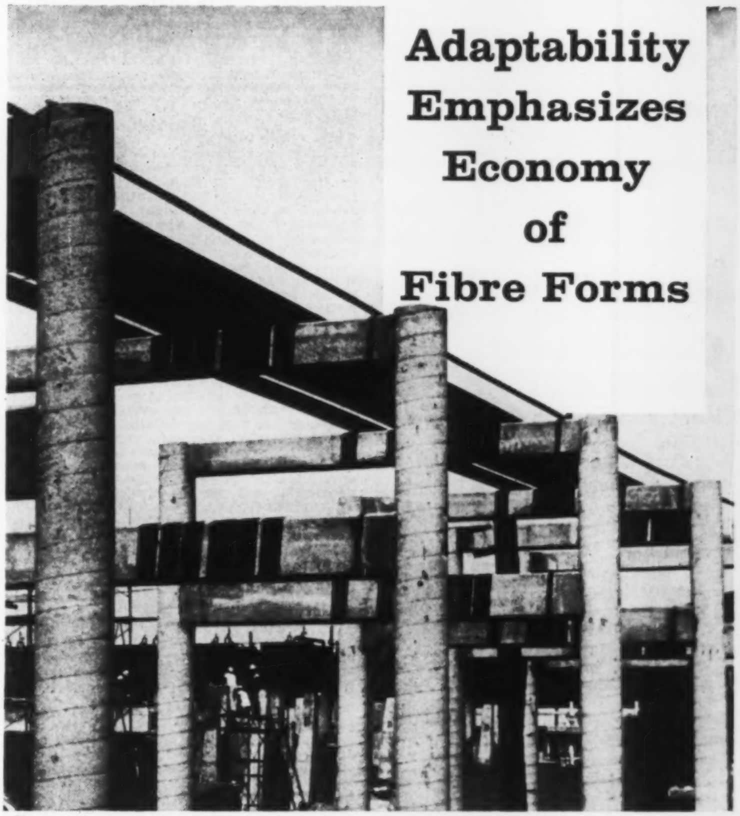
121 LIGHT STEEL FRAMING

Bethlehem Steel Company—An attractive pictorial report on various structures on the West Coast constructed with a light-steel framing has been made available. Includes diagrams and some floor plans.

122 LIGHTWEIGHT PIPE & FITTINGS

Naylor Pipe Co.—Bulletin No. 59 illustrates and describes spiralweld pipe for construction uses. Push-pull ventilation, high and low pressure air and water lines, dredging pipe, etc. in diameters from 4 to 30 in. It includes standard fittings, welded flanges, one-piece Wedgelock couplings, and connections for a pipe line requirements.

Adaptability Emphasizes Economy of Fibre Forms



Pipe supports for chemical plant.

Beam and wall tie-in is simplified . . . with

SONOCO

Sonotube®

FIBRE FORMS

Tons of piping at this chemical plant are supported by reinforced concrete beam-and-column structures. To save time, labor, and money, the round concrete columns were formed with SONOTUBE Fibre Forms.

These versatile forms can be sawed for tie-in with walls or beams, punched for utility outlets, tie-in rods, or anchor bolts, and used to form full-round, obround, half-round, and quarter-round columns and pilasters.

Lightweight and easy to handle, Sonoco SONOTUBE Fibre Forms require only minimum bracing and strip quicker, finish easier . . . form round concrete columns faster and more economically than any other method.

SONOTUBE Fibre Forms are available in several specific types, to meet various job requirements. Order sizes from 2" to 48" I.D., in standard 18' lengths or required lengths.

See our catalog in Sweet's

For complete information and prices, write

- HARTSVILLE, S.C.
- LA PUENTE, CALIF.
- FREMONT, CALIF.
- MONTCLAIR, N.J.
- AKRON, INDIANA
- LONGVIEW, TEXAS
- ATLANTA, GA.
- BRANTFORD, ONT.
- MEXICO, D.F.

SONOCO

Construction Products

SONOCO PRODUCTS COMPANY

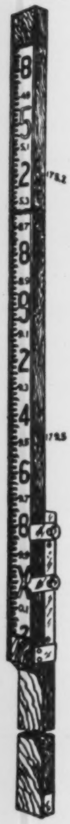
4676

In the field of
HYDRAULIC DREDGING

GAHAGAN

a leading name for over 50 years

Gahagan Dredging Corporation, 90 Broad Street, New York 4, N. Y. Write, wire, or phone Whitehall 3-2558. Cable "Walgahagan".



For Efficiency and Economy

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**LENKER
DIRECT READING
LEVEL ROD**

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Every
Rod Reading
an Elevation

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No Computations

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Awarded
Medal of Merit
for Utility
by
Franklin Institute
of Philadelphia

Write for Circular

LENKER MFG. CO.
599 CHESTNUT STREET
SUNBURY, PA.

CATALOG DIGESTS

123 LINER PLATES

Commercial Shearing & Stamping Company—Catalog 300-C2, 20 pages, with technical information on steel liner plates for excavation support in tunnel and shaft construction is now being offered. Furnishing engineering properties of tunnel liner plates, the bulletin includes tables of suggested thicknesses of plates for a variety of uses and includes a table of permissable safe loads on circular plates, installation procedures and tunneling methods.

124 LIQUID CONCRETE ADMIXTURE

Johns-Manville Products Corporation—A 32-page catalog is available on air-entraining Placewel, which when added to the mix, produces outstanding properties in the plastic and hardened concrete. It will yield from 3 to 6% of entrained air, while reducing the water-cement ratio for a given consistency by 15%, in any properly designed concrete mix. When added to a concrete of given consistency, it will provide marked improvement in workability and placeability; greatly increase compressive strength and durability while reducing bleeding and segregation. Non air-entraining Placewel is a straight liquid, water-reducing agent which, when added to concrete, greatly improves workability, durability and strength.

125 LIQUID RETARDER

Johns-Manville Products Corporation—A 16-page technical bulletin is offered on Retardwel, a retarding admixture for concrete. Architects, engineers and others concerned with construction will find the data and reports of interest. They show how Retardwel aids in overcoming problems that are inseparable elements of any hot weather concreting operation. Retardwel permits a reduction in the water required for proper placing and therefore provides the advantages that are inherent in concrete fabricated with a minimum paste content. Its use delays the initial set of concrete and provides a slower rate of heat evolution, thereby minimizing thermal stresses.

126 LONGSPAN JOISTS

Haven-Busch Company—A new 4-page supplement is now available describing T-Chord Longspan Joists with spans now up to 175 ft. Tables and design information are included for the longest span in the industry.

127 LOWBED & PLATFORM TRAILERS

Birmingham Manufacturing Company—This catalog lists standard lowbed trailers widely used in transportation of heavy machinery and platform trailers for hauling heavy industrial products; also included are Totem-All trailers for use with pickup truck.

128 MASONRY AND CONCRETE SAWS

Clipper Manufacturing Company—A folder is available on the company's complete line of products. It includes masonry and concrete saws, diamond break resistant and abrasive blades, joint sealers and diamond core bits and drills. Illustrations are included in this pamphlet.

129 MEASURING WATER FLOW

Layne & Bowler, Inc.—This 48-page booklet, No. 501, describes a simple method for measuring water flow through orifices by an investigation made by the Hydraulic Laboratory of Purdue University. Also found in the catalog: method of using orifice; factors influencing accuracy of results; and complete orifice tables and graphs.

130 MECHANICAL DRAWING EQUIPMENT

Eberhard Faber Pencil Company—Catalog sheets P-428 illustrating the new 614 Microtomic lead holder with degree window and P-429 featuring Microlar drawing pencils for use on coated drafting films, are available. Also, a full color Microtomic circular illustrates mechanical drawing pencils, woodcased drawing pencils and 521 Race Kleen, 101 Pink Pearl and 6002 Rubkleen erasers.

131 MICRO-DIST

Cubic Corporation—Bulletin 600-MD describes the firm's Micro-Dist, precision electronic surveying equipment. Features of the two-station system described in the brochure include interchangeability of stations for greater flexibility, highest accuracies, ease of all-weather operation and overall economy. The Micro-Dist system is said to make measurements from 250 ft to 50 mi with accuracies of 3 ppm plus or minus one in.

132 MIXED FLOW VOLUTE PUMPS

C. H. Wheeler Mfg. Co.—A 6-page catalog describes low and high head mixed flow volute pumps for sewage disposal, drainage, flood control, irrigation, raw water pumping, or for any relatively clear liquids. Design and construction details for both horizontal and vertical mixed flow volute pumps are included. Units are built in 12-in. through 72-in. sizes, and in 3000 to 150,000 gpm capacities.

133 MOLOX BALL JOINT PIPE

American Cast Iron Pipe Company—Molox Ball Joint Pipe for rivercrossings and other submarine service is the subject of a 32-page illustrated catalog. It contains instructions for assembly, weights and dimensions, tables and various installation procedures.

134 "MON-O-JECT" PNEUMATIC EJECTOR LIFT STATION

Smith & Loveless—A colorful 6-page bulletin on the factory-built "Mon-O-Ject" pneumatic ejector lift station contains features of design, new operational characteristics and advantages of this low-cost ejector lift station.

135 MOTOR GRADER

Galion Iron Works & Mfg. Co.—An informative 4-page bulletin on the Model 160 Motor Grader has been issued. The heavy-duty, constant-mesh, six-speed transmission of this big 160-hp grader, as well as other operating and construction features, are fully described and illustrated. Complete specifications are included.

136 MOTORIZED VALVE ACTUATOR

The Earle Gear and Machinery Company—An 8-page illustrated catalog is offered which describes the Helitork Motorized Valve Actuator, a motor driven, geared power transmitter that automatically controls position from a local or remote point and governs thrust or torque while operating all types of valves and other linear or rotating mechanisms. Illustrated with detailed line drawings, it includes ratings on the series EG actuator.

137 MOTOR SCRAPER

Allis-Chalmers Mfg. Co., Tractor Group—A 20-page catalog on the recently introduced 340-hp, 30-yd heaped TS-360 motor scraper includes full-color illustrations showing the new scraper in action.

138 MYLAR-DURALAR DRAFTING TECHNIQUE

J. S. Staedtler, Inc.—A report on the experience of top engineering firms now using the Mylar-Duralar drafting method is offered. It shows, also, the correct technique for drafting with Mars Duralar pencils on Mylar film and describes the "wash-and-print" system now possible because Mylar-Duralar drawings are waterproof, smudge-proof and tear-proof. Grime can be safely washed off, leaving the Duralar lines sharp and clear eliminating the need for costly re-drawing.

139 NON-MELTABLE MASTIC WATERSTOP

Sika Chemical Corporation—A catalog is offered on Igas Joint Sealer, to seal joints and cracks between concrete masonry and steel durably. It is for use in basement, reservoirs, swimming pools, tanks and tunnels and parking decks. It also may be used for flexible watertight membrane coating. The brochure includes joint design details.

140 OILLESS SELF-LUBRICATING BEARINGS

Spadone-Alfa Corp.—This literature describes Metaline Oilless Self Lubricating Bronze Bushings and Wear Plates for Industrial and Mechanical applications. Exclusive pre-molded lubricant assures dependable service under heavy load, high temperature, submerged and corrosive conditions. They are custom made in a wide variety of bronze alloys to meet the specific duty and application.

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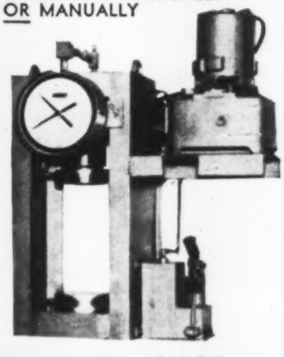

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CATALOG DIGESTS

141 OPEN FLOORING

Blaw-Knox Co.—Safety, visibility, permanence, and easy maintenance are just a few advantages of open flooring for industrial and public works applications that are described in this 8-page booklet. The literature illustrates the use of open flooring, or electroforged grating, in many industries, including steel, power railroad, paper, chemical, truck and automobile, food petroleum, aircraft, coal, and shipbuilding. In addition, the catalog features grating applications in sidewalks, locks and dams, and sewage treatment plants.

142 OPTICAL PLUMMET

Warren-Knight Co.—The Warren-Knight Optical Plummet, known as the Tele-Plumb, is exclusive in that it is fastened to the end of the Transit or Transit-Level telescope and the sight to the tack beneath the instrument is made with the full power of the main telescope. The Tele-Plumb pamphlet gives complete information on this optical plummet which saves time in setting up accurately and without the use of a Plumb Bob. The Tele-Plumb is attached permanently and the instrument can be used for regular service without removing the Tele-Plumb.

143 PACKAGE SEWAGE TREATMENT PLANTS

Walker Process Equipment Inc.—Sparjair units range in capacities from 50 to 5000 pop. equiv. to offer complete treatment plants for housing development, motels, shopping centers, etc. This package type plant produces a clear, nuisance free effluent through the contact stabilization process. Theory, operation, design factors, specifications and details are covered in bulletin 19-S-94.

144 PARSHALL MEASURING FLUMES

Thompson Pipe & Steel Company—Catalog B-31-C contains information on Parshall Measuring Flumes, which are widely used by irrigation companies, farmers, cities and industries. All steel construction assures accuracy within 2%. They are available in sizes for 0.1 to 1340.0 cu ft per second. Free-flow discharge tables, sizes, capacities and weights are included.

145 PAVING HANDBOOK

American Bitumuls & Asphalt Co.—The latest edition of the Bitumuls Paving Handbook covers a wealth of practical data on paving methods and materials. These include road and airport paving specifications and construction details, complete tabular data on asphaltic binder applications and aggregate requirements, with condensed Asphalt Institute specifications. Also, there is data on Laykold compounded asphalts for flooring, tennis courts, and protective coatings.

146 PAYHAULER

International Harvester Company—A 4-page brochure is offered on the Payhauler 19 and 27-ton models. Its features include revolutionary rock-ribbed bodies, 30% less body deadweight; 14% faster haul speeds when horsepower pays off and new 375 and 250-hp diesel engines.

147 PAYSCRAPER

International Harvester Company—A 24-page booklet is offered on the 295 Payscraper. Some of its features include rack-pinion steering system with tandem pumps that deliver equal steering response through the full course of any turn; the 295 gives a new job-proved 375-hp turbocharged diesel; and the payscraper pairs perfectly with any single engine pusher within the 131-in. cut. On the fill it's the tapered bowl, positive ejection 98-in. apron opening and no front bowl cross member that combine to pour out payloads in record time. Also available is a booklet on the 495 Payscraper and 495 Paywagon.

148 PILE DRIVING

C. L. Guild Construction Co., Inc.—An 8-page brochure, with action photographs and pictures of recently completed structures resting on Cobi Piles is available. It includes a detailed brief on piles and pile driving, with special attention to methods and specifications for installation of Cobi Cast-in-Place Concrete Piles.

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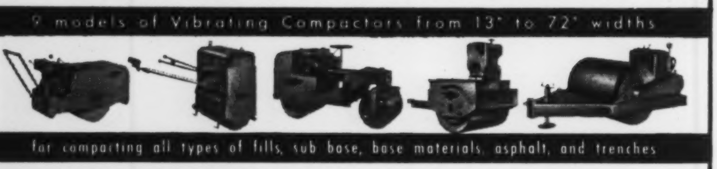

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CATALOG DIGESTS

149 PILES

Raymond International Inc.—Standard and step-tapered piles are described in Catalog S-60 which also includes information on the scope of Raymond's activities covering every recognized type of pile foundation. Domestic operations include harbor and waterfront construction, and cement-mortar lining of pipelines in place. Raymond's services abroad also include all types of general construction.

150 PIPE PILES, CAISSONS AND PILE SHELLS

Armco Drainage & Metal Products, Inc.—Pipe piles, caissons and Hel-Cor pile shells are described in a catalog dealing with uses of these products in various industries and structures. Typical applications are illustrated with tables, specifications, ordering data and a section on end closures. Basic steps in mandrel-driving Hel-Cor pile shells are shown.

151 PNEUMATIC-TIRE ROLLER

The Galion Iron Works & Mfg. Co.—Bulletin No. 434 gives complete information and specifications on the Galion 12-ton, 9-wheel pneumatic-tire roller. Illustrations clearly explain the exclusive Equamatic front end construction of the roller. This construction is claimed to provide, through the automatic equalizing action of triple king pins, utmost operating stability and balance for the roller when working over uneven and sloping ground.

152 POCKET TRANSIT

William Ainsworth & Sons, Inc.—Information is available on the Brunton Pocket Transit, which is widely used for reconnaissance and preliminary surveying on the surface and underground, for taking topography, and for geological field work. In addition to taking horizontal and vertical angles, it may be used as a prismatic compass, level, clinometer, plumb or alidade. Essentially the transit is a magnetic needle set in an accurately graduated circle in a case which opens into a versatile sighting arrangement. A level is attached to a vernier for reading vertical angles.

153 POINT TO POINT TELECOMMUNICATIONS

Marconi's Wireless Telegraph Co. Ltd.—Published three times yearly, "Point to Point Telecommunications" is designed to interpret trends and techniques in telecommunications for the benefit of the user and for the practical systems planning engineer. It deals with the more practical aspects of communications and in particular point-to-point fixed services.

154 POZZOLITH, MASTERPLATE AND EMBECO

The Master Builders Company—Two 1960 catalogs, one general and the other industrial, contain performance data and guide specifications for Master Builders products for the improvement of concrete and mortar. Some of the products included in these booklets are: Pozzolith, for the positive control of concrete quality; Masterplate, for longer-lasting concrete floors; Embeco, for non-shrink grout, concrete and mortar; and Omicron Mortarproofing, for control of mortar qualities.

155 PRECAST CONCRETE BRIDGE MEMBERS—AMDEK

American-Marietta Co.—An 8-page folder shows how Amdek prestressed, pretensioned concrete spans revolutionize bridge construction methods. It also illustrates skew beam tests, load distribution tests and tests to destruction being conducted in independent laboratories.

156 PRECAST MEMBERS

Stressteel Corporation—A brochure is offered which describes the construction innovations employed in the Medical Research Building of the University of Pennsylvania in Philadelphia. It shows how factory precast, reinforced and prestressed concrete members were tied together with high strength prestressing bars to form a rigid frame in this multi-story structure. The literature is well illustrated with detail photos.

CATALOG DIGESTS

157 PRECAST TRUSSES

Stressteel Corporation—This bulletin describes the challenging new application of precast, prestressed concrete truss segments in the cantilever construction of the Zaza River Bridge in Cuba. The unique method of casting the trusses as separate panels and the erection procedure by which they were assembled with high strength steel bars are described in detail. Information concerning the saving in time, labor and material by using the cantilever construction is given.

158 PRE-ENGINEERED SECTIONAL BELT CONVEYOR

Stephens-Adamson Mfg. Co.—Bulletin 458 is offered on the new Pre-Engineered Sectional Belt Conveyor. It features comprehensive technical data, pre-engineering advantages and an exploded view of the Sectional Belt Conveyor with all the quality components called-out.

159 PRESIDENTE CORE DRILL

Acker Drill Company, Inc.—Bulletin 31 describes and illustrates the new Presidente Core Drill. Available in two models, skid mounted or truck mounted, it can be independently powered with diesel or gasoline engine or power take-off from a truck.

160 PRESTRESSED CONCRETE

Rockwin Prestressed Concrete Corporation—Given a prime location with a commanding view on the edge of a precipice, how could a 22-unit apartment house be built economically and without destroying the site's natural charm? Literature is available on how this puzzler was solved with prestressed long span girders and cantilevered prestressed double tees. Illustrations are included.

161 PRESTRESSED CONCRETE PILES

Raymond International Inc.—Catalog CP-3 describes and illustrates Raymond cylinder piles of prestressed concrete. Information is given on the merits of prestressed concrete piles for foundations of bridges, waterfront and off shore structures. Shown are many examples of installations and suggested designs.

162 PRESTRESSED CONCRETE TANKS

The Preload Co., Inc.—"The Design of Preload Tanks", Bulletin T-19 is a completely illustrated 8-page booklet describing the design calculations for a prestressed concrete tank. Complete formulas are given for floor, wall, dome and dome ring design.

163 PRESTRESSED CONCRETE TANKS

The Preload Co., Inc.—"Preload Prestressed Concrete Tanks," Bulletin T-22, is a well illustrated, 4-page booklet describing the history of prestressed tanks, design requirements, construction, walls, and floors. Also available is a 4-page brochure, T-23, which is entitled "Prestressed Concrete." This bulletin tells of a 2,000,000 gal elevated water tank in Tyler, Texas.

164 PRICE LIST

Warren-Knight Co.—A new Price List of Warren-Knight Transits and Levels together with a replacement parts price list of accessories, etc., including prices on miscellaneous instruments, special instruments such as Precision Clinometers, Precision Quadrant Levels, Cloud Height Clinometers, Three-Arm Protractors, complete with schedule of rental rates and conditions, is now available for free distribution.

165 PROCESS EQUIPMENT

Graver Tank & Mfg. Co.—Information is available on Process Equipment such as: autoclaves, stills, sterilizers, fermenters, kettles, pots, ladles, digesters, boiler breechings, stacks, absorbers, spraydryers, towers and pressure vessels of every description. The company is equipped to handle any problem involving the fabrication of low-alloy steels, stainless, stainless-clad, nickle-clad, Monel, Hastelloy, aluminum, zirconium and titanium.

166 PROGRESS REPORT ON INTERSTATE HIGHWAYS

Bethlehem Steel Company—A 16-page report with brief summaries and photographs with captions of Interstate Highway progress in Ohio, Texas, Massachusetts, West Virginia, Michigan, and Pennsylvania is offered.

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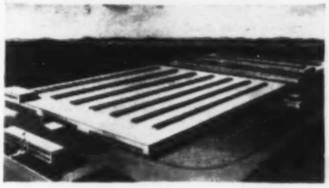

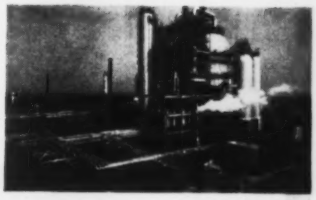

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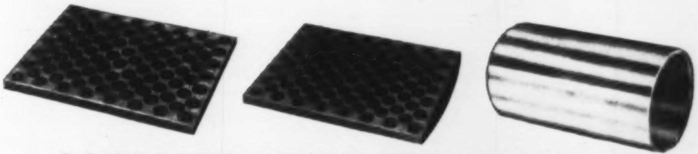
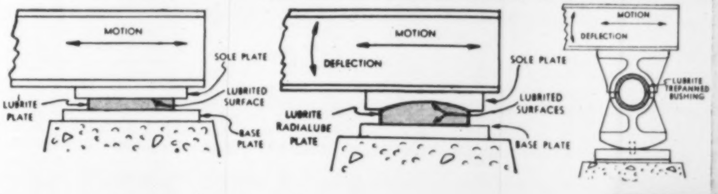


3 BASIC LUBRITE ASSEMBLIES FROM MANY AVAILABLE



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CATALOG DIGESTS

167 PROJECTOR-PRINTER

Keuffel & Esser Co.—The Kecofax Projector-Printer, an electrostatic system capable of making prints from 8½ by 11 to 34 by 48 in. from miniature negatives, is described in a 4-page bulletin. Entitled "A 34 by 48-Inch Print in 40 Seconds!", it points out that Kecofax is the first machine to break the 24-in. print size barrier—the limit for previous equipment of this type. Operation of the unit is completely automatic, the catalog says, and a finished print is produced in 40 seconds.

168 PROPELLER METERS

Measure-Rite Incorporated—Bulletin No. MR-105 gives information on propeller meters for the measurement of liquids. Free-flow design is a refinement of the basic propeller operation for low restriction of flow, minimizing loss of head. Illustration and specifications are included.

169 RAILINGS

Tubular Products, Inc.—This new catalog, featuring welded and fitted tubular railing, also provides basic engineering data and standards for railing design. One of the several unique features is a pictorial check of railing fittings which provides immediate identity and fast selection for any type railing application. Another section gives complete design details for welded and fitted railings for incorporation in drawings and specifications.

170 REFLECTING CONCRETE CURBING

Universal Atlas Cement, Div. of U.S. Steel—A 12-page catalog describes the use of Atlas White portland cement in constructing reflecting curbing and traffic markers for highways, roads and streets. It includes installation details and drawings.

171 REFLECTOR ANTENNAS

Blaw-Knox Company—Reflector antennas, specially designed and fabricated for celestial study, missile and satellite tracking, and radar control, are highlighted in a 12-page booklet, No. 2556. It illustrates equatorially mounted, aximuth elevation, and stationary type antennas, and outlines specifications for some of these units.

172 REINFORCED CONCRETE PIPE—HI-HED

American-Marietta Company—A pamphlet containing many photos showing how elliptical Hi-Hed Reinforced Concrete Pipe saves trench width in congested areas and has up to 50% greater strength than its round pipe equivalent. Includes charts on headwall details, physical characteristics and hydraulic properties and discharge graphs. Also folder on elliptical Inner Circles Pipe illustrating quick passage of pipe through pipe underground without disruption of surface traffic.

173 ROLLING DOORS

The Kinnear Mfg. Co.—According to this 36-page booklet, these rolling doors meet nine major requirements: "Registered" life extension; quick, easy operation; space saving; greater durability; fire protection; maximum safety; general protection; neat appearance; and economical installation. Steel rolling service doors, steel rolling fire doors, and bifold doors are a few of the rolling doors discussed in the catalog. Also included are specifications, photographs, and an index to door types.

174 ROOF STRUCTURES

Fluor Products Company—Glued Laminated Arches, Bowstring Trusses and Lamella Roofs are discussed in this 8-page catalog. Illustrations are included. The Douglas Fir Cross Arms data book is also available.

175 RUBBER SEAT BUTTERFLY VALVES

Henry Pratt Company—Bulletin 10AV completely describes a new line of Rubber Seat Butterfly Valves called the Monoflange Mark 11. The catalog contains all necessary information for ordering or specifying, including certified dimensional drawings. Water and gas flow data and complete prices are included.

176 SANDHOG EQUIPMENT

Mayo Tunnel and Mine Equipment—Colorful Bulletin #23 illustrates and describes tunnel shields, tunnel cars, medical locks, air locks and other sandhog equipment.

177 SCOPE IN METAL CONSTRUCTION

Pittsburgh-Des Moines Steel Co.—A 36-page General Brochure describes the capabilities and diversities of PDM Metal Construction. The facts presented serve as a useful measure of the highly developed knowledge and craftsmanship of the company in engineering, research, fabrication and construction of steel, stainless steel, stainless clad steel, alloy and aluminum.

178 SCREED ATTACHMENT

Blaw-Knox Company—A screed attachment for concrete paving spreaders that eliminates the need for an extra finisher is described in Bulletin SD-125. The literature details one particular job on which the Model 5M attachment was used to increase production considerably, and reduce maintenance and related costs $1,000 per month. The new unit also eliminates tears in concrete and requires only a single screw adjustment for making the crown.

179 SEALING COMPOUNDS PROPOSED SPECIFICATION

Thiokol Chemical Corp.—The 8-page authorized reprint of the copyrighted ASTM Bulletin No. 242, December, 1959 covers performance properties of polysulfide base sealing compounds, or equivalent, including curing agents, for use in sealing, caulking or glazing applications in buildings. Handling properties, specification requirements, and methods and evaluation of testing are included.

180 SELF LEVELING LEVEL

Umeco Optical Division—Information is available on a fully-automatic, self-leveling level, the Model AL-2. A revolutionary compensator automatically levels the line of sight accurately and maintains a true horizontal. Tubular level and tilting screw are entirely eliminated. Field tests have proven that substantial savings in time are possible with this automatic feature.

181 SELF-LUBRICATING BEARINGS

Lubrite Div., Merriman Bros., Inc.—Manual No. 56 is a 24 page book filled with complete information, technical data, and specifications about Lubrite self-lubricating bushings, bearings, and washers for industrial equipment, machinery, Hydro-electric, high temperature, missile and atomic applications. Lubrite bearings are completely self-lubricating and do not require periodic maintenance or servicing. Ideal where ordinary lubrication is objectionable, neglected, expensive to maintain or for inaccessible bearings.

182 SELF-LUBRICATING EXPANSION PLATES

Spadone-Alfa Corp.—Literature providing complete information covering Metaline oilless self-lubricating expansion plates and bridge bushings; also, Metaline bearings for underwater installations as found in dam and hydro-electric projects. Metaline products fully meet all federal and state requirements covering this type of material. This exclusive lubricant assures long, dependable service in heavy load, high temperature, submerged and corrosive applications.

183 SEWAGE LIFT STATION

Smith & Loveless—This complete engineering data manual features color bulletins on the sewage pump station and the company's complete line of pneumatic ejector sewage lift stations. The manual includes design drawings, operation characteristics, installation instructions, selection charts and complete data on lift stations.

184 SEWAGE PUMPING STATIONS

Zimmer & Francescon—A new color bulletin and technical data sheets giving complete specifications and drawings are now available on a complete line of prefabricated pumping stations for use wherever it is necessary to pump sewage or storm water. The stations hold on-the-job expenses to a minimum resulting in overall project economy. Users from coast to coast include municipalities, housing projects, sanitary districts, resorts, shopping centers, industrial parks and military installations.

185 SEWAGE REGULATORS

Brown & Brown, Inc—manufacture a line of float controlled quadrant gates, in 37 sizes, to automatically control the diversion of sanitary flows from combined sewers to interceptors. Such automatic gates may be actuated either from head or tailwaters or dually from two sources. Bulletin 81A contains capacity and dimension charts.

186 SIDEBOOMS

International Harvester Company—An 8-page booklet has been published on capacity-boosting sidebooms for the 134-hp. TD-20 crawler. It contains specifications and illustrations. Also available is literature on the SBI-150 Sideboom.

Please give your complete address.

187 SIMPLE-SPAN BEAM

John A. Roebling's Sons Division The Colorado Fuel & Iron Corp.—Engineering Bulletin PC-946 is entitled "Design Procedure for a Simple-Span Prestressed Concrete Beam". Its contents are based on ACI-ASCE Committee 323 report "Tentative Recommendations for Prestressed Concrete." It is an excellent guide for engineers designing prestressed concrete members.

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CATALOG DIGESTS

188 SKID-SHOVEL

International Harvester Company—Two 16-page booklets are offered on the 4-in-1 Skid-Shovel, which is 4 prime construction units—a bulldozer, scraper, skid-shovel and clamshell. Basically, it consists of a super-strong, 2-segment bucket which can be positioned four ways. Each of the four "machine selector" settings forms an efficient, specialized piece of equipment. Change-over from one unit to another takes only a second or two.

189 SLURRY SEAL

American Bitumuls & Asphalt Co.—"Bitumuls Slurry Seal" is an operation which consists of mixing the aggregates with Bitumuls and water to a slurry consistency in a transit mixer, and spreading over the pavement by a specially constructed squeegee type spreader-box. The action of the squeegee forces the slurry into the fine cracks of a weathered but still sound surface of an old asphalt pavement, thereby reducing expensive maintenance patch construction to a minimum.

190 SMALL TANDEM ROLLERS

The Galion Iron Works & Mfg. Co.—The operating and construction features of 3 to 5-ton and 4 to 6-ton variable weight tandem rollers are fully described and illustrated in Bulletin No. 435. Also included is a pneumatic-tire towing attachment for the 3-5-ton size roller, which permits the roller to be towed from job to job by any truck. The 4-6-ton tandem roller comes equipped with a set of retractable towing wheels which are hydraulically lowered into towing position whenever it is desired to move the roller to another location.

191 SOIL COMPACTION

Vibroflotation Foundation Co.—Available is a booklet entitled "Soil Compaction by Vibroflotation" which describes the soil consolidation and engineering services of the Vibroflotation Foundation Co. The booklet illustrates the compaction of 8 to 10-ft cylinders of sandy soil to provide a firm foundation of sand for any type of structure. To make sure of complete coverage in a given area, these cylinders are overlapped according to a predetermined pattern under individual loadings or under entire building areas.

192 SOIL TESTING DEVICE

Charles R. Watts Co.—Full information is offered on the Washington Dens-O-Meter, developed by soils engineers of the Department of Highway, State of Washington. Now in use throughout the world for making field density and moisture tests in a wide range of soils, it is accurate and fast in small or large holes up to ½ cu ft—3 ft deep in fine, coarse, granular base and gravels.

193 SOLAR EPHEMERIS AND POLARIS TABLES

C. L. Berger & Sons, Inc.—The 1960 Edition of Solar Ephemeris and Polaris Tables consisting of 88 pages of valuable information is available. The price is 35 cents.

N. B. There is a charge for this book. Make checks payable to C. L. Berger & Sons, Inc.

PLEASE PRINT NAME CLEARLY

194 SPECIAL PURPOSE INSTRUMENTS

Warren-Knight Co.—Folder SP illustrating and describing the company's special purpose instruments including Sight Clinometers, Precision Vernier Clinometers, Precision 3-arm Protractors, 15-deg Precision Quadrant Levels, 180-deg Variable Setting Clinometers, 110-deg Precision Quadrant Levels, Precise Mounted Levels and Precise Prismatic Reading Levels, is now available. The bulletin also includes information pertaining to mounted and unmounted level vials with illustrations of three frame types, with dimensions, sensitivities and prices.

195 SPEED REDUCERS

The Earle Gear and Machinery Company—A sixteen-page illustrated catalog, describing speed reducers as applied to operating machinery, particularly bridge machinery, is available. Outlined are specifications, service factors, horsepower ratings and dimensions of the particular units illustrated. Gasoline power units are also dealt with in a compact, easy-to-read form. Photographs are shown of actual installations with miniature blueprints included.

196 SPLIT-SECOND FASTENING METHOD

Nelson Stud Welding Div., Gregory Industries, Inc.—"Nelson Stud Welding in Construction" illustrates the major cost-saving applications of this split-second method of fastening to steel or aluminum and describes the process. Applications included are: field-assembled sandwich walls, single skin metal roofing and siding, shear connectors for composite construction and concrete anchors.

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CATALOG DIGESTS

197 STEEL

Mississippi Valley Structural Steel Company—This 28-page booklet entitled "Build Better with Steel" includes sections on famous steel-framed structures, steel versus concrete in Manhattan high-rise buildings, famous Mid-Western steel structures, fabricated steel for industrial uses, and steel erection services. Illustrations are also contained in this brochure.

Return the coupon today!

198 STEEL CONSTRUCTION AND FIELD SERVICES

Yuba Consolidated Industries, Inc.—Pictured and described in this 2-color, 12-page brochure are many of the notable steel construction and field erection projects completed by the company during its century of experience—bridges, buildings, penstocks, storage tanks, and a diversity of custom structures. Other services offered by the construction divisions include equipment installation and industrial maintenance.

199 STEEL GRANDSTANDS

Pittsburgh-Des Moines Steel Company—A 4-page illustrated folder thoroughly describes construction, design factors, seat spacing, aisle width, specification check points and over-all advantages of these permanent stands for outdoor seating. Formulas for calculating seaing capacities are provided, and capacity tables. Types of stands pictured include school, racetrack, baseball and fairground structures. Unit construction and adaptability are features of PDM Steel Grandstands.

200 STEEL GRATING AND STAIR TREADS

Kerrigan Iron Works Co.—Revised 16-page Picture Story of Kerrigan catalog contains complete engineering data on welded steel grating and treads. Fabrication, testing methods and installation photos are included.

201 STEEL MILL LOADER

The Eimco Corporation—A new brochure, No. L-1106, outlining the many uses and features of the various special Steel Mill Loaders is now available. Specification highlights of the 115 Excavator, 133 and 136 Special Steel Mill Front End Loaders and other units, are given and on-the-spot photographs show the units in use in steel mills all over the world.

202 STEEL PRODUCTS

The Colorado Fuel and Iron Corporation—This 28-page brochure "blueprints" the principal steel components, tools and materials that the company manufactures for the construction industry. Some of the tools described include grader blades and cutting edges, grinding rods and wire rope and slings. Construction materials include fabricated steel plate structurals, nails and staples, reinforcing bars and tie wire. Illustrations are also contained in the booklet.

203 STEEL PRODUCTS FOR CONSTRUCTION

Inland Steel Company—Complete specifications on construction products are available. Included are wide flange beams, sheet steel pilings, bearing piles, wall armor tees, piling connections, standard structural shapes, steel plates, sub-purlins and 4-Way Safety Plate. The section on high-strength steels covers tensile requirements, chemical composition, bend test requirements, fabricating practice for cold-forming and typical properties of high-strength steels, including High-Strength Structural Steel—Hi-Man 440, which meets the requirements of the new ASTM Specification A-440.

204 STEEL RESERVOIRS AND STANDPIPES

Chicago Bridge & Iron Company—A new 24-page brochure describes Horton steel reservoirs and standpipes. Liberally illustrated with structures of all styles and capacities, the booklet includes dimensional data on all sizes.

205 STRATAGRAPH

Edo Corp.—An illustrated brochure describes the Model 400 Stratagraph, strata penetrating sonar which records, with sharp definition and complete accuracy, formations underlying rivers, lakes and other relatively shallow bodies of water. Sediment, intermediate layers, bed rock and faults are readily distinguished and pictorially shown on permanent chart. The brochure illustrates equipment and typical recordings.

206 STREET LIGHTING GUIDE

Kerrigan Iron Works Co.—A 20-page guide to planning and promoting street lighting programs is offered. Entitled "A Bright City Is a Safe City," it contains information on planning, specific aids, such as discernment methods, glare, light distributions, mounting heights and traffic volume charts. It illustrates and describes relighting of specific cities and towns.

207 STRUCTURAL BEARING BOLTS

Automatic Nut Co., Inc.—Engineering data and descriptive literature are available to architects, engineers, contractors, and fabricators on High Tensile Structural Bearing Bolts with Interrupted Ribs used in conjunction with Anco lock nuts; no torquing is required. Also available is literature on Anco self-locking hex nuts.

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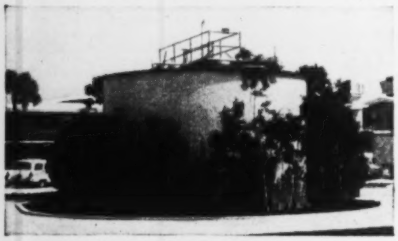

SPARJAIR Unit installed at a large Florida motel to handle 25,000 gpd combined sanitary and restaurant wastes. Note proximity of plant to motor court. Odor-free operation eliminates need of isolating plant.

SPARJAIR UNIT — Nested Contact Stabilization Plant — an easy to operate, low cost, small sewage treatment plant that is a model of simplicity. Designed on a new but proven principle, the contact stabilization process aerates and thoroughly oxidizes all odors in the sewage and overcomes previous objections to locating a plant near residences, shopping areas, schools, etc. Raw sewage settling tanks and septic digesters are eliminated. This plant utilizes a separate chamber for complete aerobic digestion (42% volatile remaining) of excess sludge.

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CATALOG DIGESTS

208 SUBGRADER & ATTACHMENT

Blaw-Knox Company—An 8-page bulletin, No. 2652, covering the precision subgrader and a 2-page sheet, No. SD-124, covering the deep cut attachment, are now available. The deep cut attachment is designed for air base work and offers cutting depth range from 12 to 24 in.; it is for installation on GB and GC models. Other features of the subgrader, which excavates through vibration, include: two ranges of excavating widths for single or dual lane paving, fully adjustable strike-off, quick adjustable crown control, self-powered reverse travel, and fingertip hydraulic depth controls.

Turn to page 138 and order your literature.

209 SURFACE TREATMENTS

American Bitumuls & Asphalt Co.—"Bitumuls Surface Treatment Manual" is a two-color, 64-page round-up of factual, practical information on all phases of this type of pavement maintenance. Of special note is the attention given to proper evaluation of pavement distress ahead of specifying type of treatment. The manual is heavy on the "how-to" aspects of treatments, from "Black Seal" through "Armorcoats." Other features include a "Glossary of Terms" and a section of useful tables.

210 SURVEY DEPTH RECORDER

Edo Corp.—Literature describes and illustrates Model 255C Survey Depth Recorder, with sample recordings. Precision sonar equipment measures depth of water (0-230 fathoms) with great accuracy. Compact unit is readily installed on all types of survey vessels.

211 SURVEYING INSTRUMENTS

C. L. Berger & Sons, Inc.—A series of descriptive folders illustrating surveying instruments is now available. General characteristics are fully described with essential specifications for each instrument.

212 SURVEYING INSTRUMENTS

Fennel Instrument Corp. of America—A low priced Optical Plummet Transit and Self-Leveling Level, one second and one minute theodolites, enclosed and standard A and U frame transits, tilting levels, 18-in. levels, convertible transit levels, and builders levels, are covered in a new group of leaflets and a catalog folder.

213 SURVEYING INSTRUMENTS

W. & L. E. Gurley—The complete line of Gurley surveying and engineering instruments, including transits, levels, alidades, are described in the revised edition of Catalog 50. Transits described include the Hell Gate Precise Transit; Standard Precise Transit; Gurley Telescopic Solar Transit; Standard Precise Mining Transit; Optoplane Precise Transit for industrial use; Optical Plummet Transit. Included are cross-sectional drawings of many of the transits.

214 SURVEYING INSTRUMENTS

Kern Instruments, Inc.—A 32-page brochure offers a brief description of the most important instruments manufactured by Kern & Co., Ltd., of Aarau, Switzerland. Fully illustrated, it acts as an index to the detailed literature available on each instrument. Included in the brochure are theodolites, levels, self-reducing tachometers, alidades, pentagonal prisms and many other instruments.

215 TECHNICAL CATALOG

F. W. Dodge Corporation—A new 40-page catalog of books on architecture, engineering, construction and allied subjects is now available.

216 TECHNICAL FOUNTAIN PEN

Koh-I-Noor Pencil Company, Inc.—Literature is available on the Rapidograph Technical Fountain Pen, which has 7 interchangeable points for 7 line widths. This model is non-clogging and easily cleaned when used with either India or regular writing ink for drafting, ruling, guide and freehand lettering, tracing, writing and commercial art work.

217 TECHNICAL PAPER

Clearprint Paper Co.—Some of the products contained in this booklet are: Clearprint 1000, a technical paper for drawing and tracing; Papercloth, a technical paper of cloth durability; graph paper; and Fade-Out paper. Price lists and specifications are also included.

218 TESTING APPARATUS

TESTlab Corporation—Digest No. 2 contains 16 pages devoted to new and improved testing apparatus relating to soils, bituminous, concrete and general testing. Items that should be of interest to most materials testing engineers include: redesigned Wheeler sieve shaker; controlled humidity cabinets; precision direct reading humidity indicator (hygrometers); and mobile truck or trailer laboratories for on-the-job testing. Of special interest to the soils engineer are: a new type of pocket penetrometer for quick strength tests; improved miniature compaction apparatus; and a drilling rig designed for soil testing.

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CATALOG DIGESTS

219 THE MARCONI REVIEW

Marconi's Wireless Telegraph Co. Ltd.—Devoted to the advancement of the science of radio engineering, this technical journal contains articles on the latest research and development in the fields of radio and electronics. Published quarterly, "The Marconi Review" is written primarily for the laboratory worker and reflects the highest standard of industrial research. The subscription rate is £1.0.0. annually, postage free to any part of the world.

220 THE MECHANICS OF MODERN MIRACLES

Eugene Dietzgen Co.—This 36-page booklet illustrates and describes actual case histories of specific drafting and print making problems that have been solved by the use of certain advanced techniques and products that have been developed by the company.

221 TIDE GATES

Brown & Brown, Inc.—Literature fully describes a complete line of metal tidal gates in 22 circular sizes and 47 rectangular sizes. Also described are timber gates to meet any requirements and a line of cushioned flap gates for use on pump discharge lines. Dimensional and loss of head data are given.

222 TILTING PAN FILTERS

The Eimco Corporation—An 8-page bulletin, No. F-2038A, on Tilting Pan Filters describes recent developments in the design of this specialized filter that makes it highly effective for filtering a broad range of free-flowing, fast-settling materials. The brochure defines the area of application of tilting pan filters in chemical and metallurgical processing, and contains a visual representation of a single filtration cycle showing time segments for wash, air sweep, cake discharge and vacuum purge.

223 TL-16 TRACTOLOADER

Allis-Chalmers Mfg. Co., Tractor Group—A 6-page catalog on the 7,000-lb capacity TL-16 TractoLoader includes a convenient chart which shows how to choose the correct bucket capacity for the loader according to the weight of the materials to be handled and the condition of operating surfaces.

224 TOTAL FLOW METER

Leupold & Stevens Instruments, Inc.—The Model 60M Total Flow Meter, designed to meet the need for a low-cost, yet accurate and dependable, instrument for measuring the flow of sewage, industrial wastes or other liquids in open channels, is described in Bulletin 28. Compact and portable, mechanically operated, requiring no external power and with interchangeable cams and scales for measuring flumes and weirs, it is unusually versatile in its applications.

225 TRANSIT

Umeco Optical Division—Literature is offered on an imported, precision, 6¼-in. transit. Weighing 16½ lb, the instrument has an erecting, 28 power, 11½-in. telescope with coated lenses, resolving 3.5 sec of arc. The 40-mm objective provides a brilliant image. The horizontal circle is 6¼-in. in diameter with graduations reading direct to 20 min; double numbered 0-360 and 360-0, with figures inclined in direction of increase. Verniers read down to 20 sec.

226 TRANSIT INSTRUCTION MANUAL

Texas-Asiatic Import Co.—This 17-page manual covers the most common adjustments, plus maintenance and other information on the Eagle Mountain Transits and Standard Transits. It is vest pocket size and each heading is indexed for easy reference in the field. It also shows parts and catalog numbers of parts on Eagle Transits, for convenience in ordering replacements. A section shows the use of the Eagle Stadia Arc with examples described.

In filling out the coupon, please print clearly and be sure that you furnish a complete address.

227 TRANSITS AND DUMPY LEVELS

Texas-Asiatic Import Co.—This literature describes the Eagle 6-in. Standard Transits (20-sec and 1-min horizontal verniers), which are made of solid bronze, with a unique 11-piece optical system and several refinements not found on any other instrument. It also describes the Eagle Engineer's Dumpy Levels, which are avaible in both an 18-in. and 15-in. model.

228 TRI-ACETATE SHEETS

Stanpat Company—Circular describing their printed adhesive-backed acetate sheets for speeding up drafting is available. These sheets are attached to original drawings and save draftsmen from redrawing standard details and repetitive notes. Resulting prints are clear and sharp and save tremendous amount of time.

229 TRUE MERIDIAN IN DEFENSE PLANT

Kern Instrument Inc.—Civil Engineers reprint describes the use of a Kern Theodolite to solve the difficult problem of establishing a true meridian inside of a defense plant for testing of weapons components.

230 TRUNNION ANCHORAGE PRESTRESSING

Stressteel Corporation—This booklet describes the application of prestressing to trunnion anchorages of tainter gates in dam construction. Details of the design presently incorporated into the plans of a number of major dam projects, both government and private are given. Construction is described and a sample set of specifications are given.

231 "T-1" STEEL

Lukens Steel Company—A description of the company's "T-1" steel, its properties, uses, and fabrication techniques are included in this brochure.

232 TUNNEL AND MINE EQUIPMENT

Posey Iron Works, Inc.—A bulletin is available which describes and illustrates round conduit forms, full round non-telescopic tunnel forms, adjustable box forms, self-dumping skips, muck bins, man and material cages, and skip guide towers, pertaining to all types of steel forms and shaft equipment for tunnel and mine usage.

233 TUNNELS

Spencer, White & Prentis, Inc.—"Famous Subways and Tunnels of the World," by Edward and Muriel White recounts the fascinating history of subways and tunnels from earliest times. The price is $2.75.

N. B. There is a charge for this book. Make checks payable to Spencer, White & Prentis, Inc.

PLEASE BE PATIENT
YOUR REQUESTS TAKE TIME

234 TYING AND ANCHORAGE SYSTEMS

Richmond Screw Anchor Co., Inc.—Bulletin #9 provides data and details on particular products and special conditions of use on heavy construction projects. It includes illustrations of Cantilever Form Anchorage products and Tying Systems for locks, dams, powerhouses and tunnels.

235 TYLOX "C-R" GASKETS

Hamilton Kent Mfg. Co.—A 4-page brochure in color fully describes and illustrates the use of Tylox "C-R", a new rubber gasket for recessed sewer pipe which cannot roll or twist out of position during pipe coupling operations. The gaskets are of the "snap-on" type for recessed concrete pipe of all sizes ,and of either bell and spigot or tongue and groove types. They may be made of rubber or neoprene, and form a leak-proof, acid-resistant seal when pipe is coupled.

CATALOG DIGESTS

236 TYLOX "C" SERIES GASKETS

Hamilton Kent Mfg. Co.—A 4-page brochure in color fully describes and illustrates Tylox "C" and "C-P" sewer pipe gaskets now being made available to engineers and contractors. "C" and "C-P" and "snap-on" gaskets designed for concrete pipe of all sizes, with single or double offset, and provide true compression, leak-proof joints capable of withstanding pressures up to 50 ft. They are furnished in either rubber or neoprene, and may be installed on the pipe either at the pipe manufacturer's plant, or by contractors at the job site.

237 UNDERPINNING

Spencer, White & Prentis, Inc.—"Underpinning," a book by Edmund Astley Prentis and Lazarus White is recognized as the authoritative source for information in the field by engineers, architects and contractors all over the world. The price is $10.

N. B. There is a charge for this book. Make checks payable to Spencer, White & Prentis, Inc.

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238 UNITIZED MOBILE BATCHING PLANTS

The Heltzel Steel Form and Iron Co.—4-page Bulletin #60-28 describes the Unitized Mobile 100-ton Batching Plants available in several types. Plants are unitized in two "complete package" sections containing factory-installed batcher scales and all controls. Both sections have self-contained transportation wheels and towing tongue for over-the-road moving. The brochure details speed of erection and dismantling, and provides case history by the user.

239 "VAC-O-JECT" PNEUMATIC SEWAGE EJECTOR

Smith & Loveless—A new bulletin on the factory-built installation in a wet well or receiving manhole is offered. The brochure describes design features, operational characteristics and advantages of this low-cost ejector station available in simplex and duplex units.

240 VALVES

Allis-Chalmers Mfg. Co., Hydraulic Div.—Howell-Bunger valves for power, flood control, irrigation, drainage, turbine bypass, and aeration of water are described in Bulletin 02B9206. The valves have a wide range of application where easy, efficient regulation and control of water flow under free discharge is demanded.

241 VAPOR SEAL MANUAL

W. R. Meadows, Inc.—A manual has been prepared covering practical application of the "premoulded Membrane" Vapor Seal. This booklet covers architectural and engineering data, technical information, various applications and specifications.

242 VIBRATION AND SHOCK ISOLATORS

Voss Engineering, Inc.—Comprehensive technical manual will assist engineers in solving vibration and shock problems with Sorbtex preformed fabric neoprene and rubber pad materials. New concepts in the use of Sorbtex are presented for the first time.

243 VIBRO-PLATE

Wacker Corporation—Literature is offered on the Vibro-Plate for finishing of sandy or granular material and hot or cold asphalt and, for the densifying of dry mix, concrete with coarse aggregates and soil cement. Some of the features include: no air lines or auxiliary equipment; develops more than 1700-lb impact—5000 per min; self-propelled—30 ft per min; weighs only 135 lb; and the "built-in" water supply prevents asphalt sticking.

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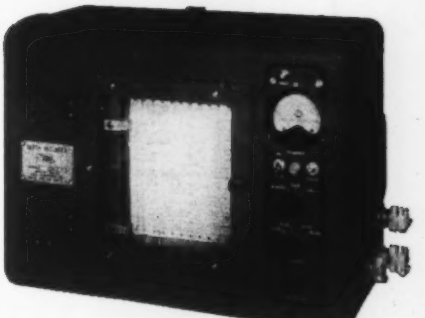

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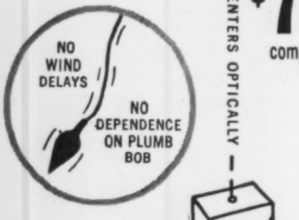

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CATALOG DIGESTS

244 VIBRO-RAMMER

Wacker Corporation—Information is available on a new type of compactor used for all kinds of backfill including clay. It has dynamic impact—10 powerful blows per sec; light weight, it weighs only 115 lb; and it is quick starting and easy to operate.

245 VISQUEEN FILM

Visking Co., Plastics Division, Division of Union Carbide Corp.—New booklet "LOW COST CURES" describes the use of visqueen film for curing blankets and slab underlays. White opaque film is used for maximum reflectivity. It retains moisture and reduces temperature fluctuations to produce uniform cure, stronger concrete. Underlays conserve cement solution and protect concrete from ground moisture. Film is waterproof, tough, lightweight and reusable; it won't rot, crack or peel.

PLEASE BE PATIENT
YOUR REQUESTS TAKE TIME

246 V-LOK DESIGN MANUAL

Macomber Incorporated—A V-Lok Design Manual MV-60, will be available listing all structural components with load tables, engineering type framing plans and design information with engineering formulas to arrive at the most economical framing plan. Three sections—Warehouses & Industrial Buildings, Shopping Centers & Commercial Buildings and School Design—will provide wall, eave and roof details to scale for direct application to drawings.

247 WATER PIPE

Southern Pipe Division, U.S. Industries, Inc.—A new 16-page two-color brochure on the company's new Steelcor line of water pipe products includes such basic information on Steelcor Cemcote, cement-mortar lined and coated steel water pipe, as detailed specifications and design tables covering pressures from 50 to 450 psi. New design charts simplify pipe specifying. All necessary engineering data is included.

248 WATERSTOP MANUAL

W. R. Meadows, Inc.—The availability of a manual on "Sealtight" PVC Waterstops has been announced. It describes applications, installation information, product specifications and engineering data, and gives complete range of product sizes and types.

249 WATER SUPPLY CONSTRUCTION

Ranney Method Water Supplies Inc.—Various types of water supply construction including the Ranney-Collector for developing ground water and infiltrated water supplies and for dewatering purposes, and caisson-type water intake structures are described in illustrated booklets "Supplying Water for Municipal and Industrial Use" and "Construction Services for Engineers and Construction Companies" in the fields of water supply, waste disposal, sewage treatment and dewatering.

250 WATER, WASTE & SEWAGE TREATMENT EQUIPMENT

Walker Process Equipment Inc.—A 24-page, two-color bulletin, No. G50, describes and illustrates the major items of equipment offered by this firm for municipal and industrial water and waste treatment. It also includes description of the Company's facilities for equipment engineer, laboratory and manufacturing activities.

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AMERICAN CANCER SOCIETY

CATALOG DIGESTS

251 WATER WELL CASING

Thompson Pipe & Steel Company—Catalog B-15-B discusses Well Casing of mild or stainless steels, which is made with a choice of 5 perforations to suit all soil and corrosion conditions. There are many accessories and field joints from which to choose.

252 WATTS AUTOSET LEVEL

Eugene Dietzgen Co.—A 5-page two-color folder that completely describes and illustrates the new automatic level called the Watts Autoset Level is available. Four diagrams describe the difference in operation between a conventional level and the new Autoset Level.

253 WATTS MICROPTIC THEODOLITE

Eugene Dietzgen Co.—A 6-page folder illustrates and describes both the distinguishing features and specifications of the Watts Microptic Theodolite #1 and #2. Information on the new Autoset Level, the Microptic Engineer's Level and the Precise Level is also included.

254 WELDED STEEL GRATING

Rockwell-Standard Corporation, Grating Div.—A 6-page booklet is offered on Gary Welded Steel Grating with the hexagonal cross bars. Engineering data and illustrations of different applications are also included.

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255 WELDING ELECTRODES

Hobart Brothers Co.—This comprehensive welding electrode catalog covers the manufacturer's complete line of welding electrodes, gas welding rod, non-consumable electrodes, submerged arc welding flux and automatic welding wire. In addition to a handy application diagram the following information is given for each electrode: description, color code, outstanding features, mechanical properties, typical chemical analysis of weld metal, approvals, conformances, size, current range, packaging, procedure and typical applications.

256 WELLPOINT DEWATERING

Griffin Wellpoint Corp.—"The Griffin Wellpoint System", a 32-page digest showing a wide variety of wet jobs, many of which present unusual dewatering problems, is now available.

257 WELLPOINT DEWATERING

Griffin Wellpoint Corp.—"How to Handle Wet Jobs," a brochure presenting successful solutions to unusual pre-drainage problems is available.

258 WELLPOINTS

Moretrench Corporation—A 4-page bulletin illustrating and describing standard and special types of Moretrench Wellpoints and their use in various types of jobs has been made available.

259 WELLPOINT SYSTEM

Moretrench Corporation—An informative 76-page catalog, fully illustrated, describes the Moretrench wellpoint system and its use in dewatering various types of construction projects. It includes useful technical data on the system.

260 WINDOWS & CURTAIN-WALLS

William Bayley Co.—Windows and Curtain-walls, steel or aluminum, are described with catalogs. Catalog S-60 covers steel windows and doors; Catalog C-60 covers curtain-wall systems and panels; Catalog A-60 covers aluminum windows; and Catalog D-60 covers detention window systems.

261 WOOD & STEEL TYPE DOORS

The Kinnear Mfg. Co.—The catalog and data book discusses fully and illustrates the advantages, the economy, the construction features and the general specifications of the various types of wood and steel upward-acting type doors. Known as Bulletin 101 it gives information on installation, clearance requirements, methods of operation and controls, as well as adaptability of the doors for many types of uses.

262 WRITING INSTRUMENTS

Venus Pen & Pencil Corporation—Free samples are available of Venus "Col-Erase"—the colored pencil that erases as cleanly as black lead pencils; the "All-Purpose" Writing Pencil with "all-purpose" lead for every writing need; Venus Drawing Pencils for use in drafting; and Venus Blueprint Pencil with chemically treated lead.

263 SMALL PLANT SEWAGE TREATMENT

Dorr-Oliver Incorporated—An 8-page, two-color bulletin, No. 6692, entitled "Small Plant Sewage Treatment," describes the design, operation and advantages of four units particularly applicable to small scale operations. The Clarigester, Degritting Clarigester, Duo-Clarigester and CompleTreator, provide both sludge digestion and clarification in a single tank, and three of the four provide additional treatment steps as well.

264 CLAY PIPE

National Clay Pipe Manufacturers, Inc.—A 6-page brochure, "Clay Through the Ages", is of particular interest to professional engineers. It contains lists of ASTM, ASA and AASHO specifications applicable to vitrified clay pipe, and describes new factory-made pipe joints. Clay processing today, and the typical characteristics of vitrified clay pipe also are included.

265 CLAY PIPE

National Clay Pipe Manufacturers, Inc.—This 48-page fully illustrated brochure entitled "The Story of Clay Pipe" contains an historical record of clay pipe, its contribution to America from the beginning of the 20th century to the present, and a look into the future of American homes, industries and communities.

266 ORGANIZATIONAL PROBLEMS OF COMPUTER INSTALLATION

Bendix Computer Division—A 20-page booklet based on experiences with consulting engineer organizations in the civil engineering field is available. The information is based on an appraisal of the problems and decisions that confront an engineering organization contemplating use of an electronic computer. The article was originally prepared by Elwyn H. King and Alfred Benesch and Associates for presentation at the Fifth Illinois Structural Engineering Conference held at the University of Illinois, December 1958.

267 DIGITAL COMPUTER

Bendix Computer Division—A 6-page illustrated bulletin describes highlights of the G-15 Digital Computer with particular emphasis on the magazine-loaded photo tape reader which is offered as standard equipment. Also included are descriptions of Pogo and Intercom 1000 programming systems; accessory punched card, magnetic tape and paper tape equipment; several special purpose devices and G-15 specifications.

268 DEPTHOMETER, CAMERA LOCATOR

Bludworth-Marine—Literature describing the single transducer survey depthometer ES 130, which is portable, weighs under 40-lb and performs with great flexibility and precision, is available. Also provided is information on an underwater TV camera with a continuous picture on monitor screen on boat or land, with depths to 180-ft; and a metal locator which pinpoints ferrous and non-magnetic metals in fresh and salt water. Pressurized to depths up to 160-ft, this locator weighs 1½-lb submerged.

269 TORQUE-FLOW PUMP

Wemco, Division of Western Machinery Company—A 4-page catalog is available on the torque-flow pump. In coal, limestone, cement, chemical, metallics, industrial wastes, meat packing, food products, viscous or corrosive products, crystals, liquors, paper pulps, wood products, and many other industrial applications, the pump continues to operate without difficulty—no clogging or stoppage, no shutdown, and product handling costs are cut substantially. Industrial applications are included in this pamphlet. Also available are an Engineering Data bulletin and a catalog on a Torque-Flow Sewage Pump for all phases of the sewage treatment operation.

There are 269 Digest items on pages numbered 138 to 165. Read all items for the literature of interest to you.

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Journals: Highways, Hydraulics, Sanitary Engineering, Structural, Waterways and Harbors.

2393. Serendipity and the Development of Experimental Meteorology, by Vincent J. Schaefer. (IR) Scientific developments leading to the discovery of cloud-seeding are described. The difficulties and importance of understanding mountain meteorology are presented. Improvements in forecasting of weather phenomena are to a large extent dependent on such an understanding. The engineer's role in experimental meteorology is explained.

2394. Experiments on Treatment of Summer Cumulus Clouds, by Louis J. Battan and A. Richard Kassander, Jr. (IR) During 1957 and 1958, the University of Arizona carried out a program of cloud-seeding research directed toward the study of the effects of silver-iodide nuclei on supercooled orographic cumuli. Clouds over the Santa Catalina Mountains in southeastern Arizona were studied.

2395. Physical Studies of Santa Barbara Storms, by Theodore B. Smith. (IR) In order to understand the physical effects of cloud-seeding, it is necessary to understand the natural mechanism of precipitation formation and their variations. Present (1960) observing networks are too sparse for an adequate study of existing precipitation processes. Several observing techniques for this purpose have been used during the Santa Barbara Project.

2396. Seeding of West Coast Winter Storms, by Robert D. Elliott. (IR) Weather modification has emerged as an important engineering application of the science of meteorology. This paper describes both the manually operated silver-iodide smoke generator and the remote-controlled generator operated by radio. Finally, the economic effects of cloud-seeding are evaluated.

2397. Seeding of Clouds in Tropical Climates, by Wallace E. Howell. (IR) A synopsis of cloud-seeding experiments shows substantial agreement among experimenters that seeding with spray or hydroscopic particles often dissipates small warm clouds, but often stimulates convective activity and initiates or increases rainfall from clouds that exceed approximately 4,000 ft in depth, increasing rainfall 50% or more; while seeding with dry-ice or silver-iodide, for effect in supercooled clouds appears to produce a smaller but still considerable precipitation increase. A new model of convective cloud fields is proposed.

2398. Generator Technology for Cloud-Seeding, by D. M. Fuquay. (IR) This paper describes experiences in the development and calibration of solution and string-type silver-iodided generators for use on Project Skyfire lightning studies.

2399. Cloud-Seeding Results in Santa Clara County, by Arnett S. Dennis. (IR) An account is given of a cloud-seeding experiment conducted in Santa Clara County, Calif. during three consecutive winters starting with 1955-56. Analysis of results shows a probable increase of from 15% to 28%, due to cloud-seeding.

2400. Advisory Committee on Weather Control, by Frederic A. Berry. (IR) The investigations of the Advisory Committee on Weather Control are described, as well as its principal findings. The information obtained was of great importance to the field of atmospheric physics and the science of weather modification.

2401. The Nature of Cloud Systems, by Horace R. Byers. (IR) Cloud systems suitable for modification by seeding are described. The mechanisms of precipitation formation and results obtained from seeding various types of clouds are briefly considered.

2402. Physical Properties of Clouds, by Roscoe R. Braham. (IR) To form an idea of the difficulty involved in evaluating cloud-seeding effects, the problem can be compared with the study of human genetics. In the past most seeding effects were indicated by straightforward statistical evaluations. Now more tests, which are popularly called "physical evaluations," are being conducted. Nine of these physical evaluations are presented in this paper.

2403. Evaluation of Seeding Trials, by Arnold Court. (IR) Proper evaluation of a cloud-seeding program, from the customer's standpoint, should be in terms of his desired end product; kilowatts, bushels of grain, or pounds of meat. Failing this and for the benefit of meteorolgy, evaluation should cover all possible effects of cloud-seeding: rain intensity, rain temperature, wind-speed, etc.

2404. Natural Variability of Storm, Seasonal, and Annual Precipitation, by Glenn E. Stout. (IR) Statistical evaluations of seasonal and annual rainfall variability are presented. Analyses were made to show the variability of natural rainfall, which may occur among five comparable areas, and to show the differences that may naturally occur between control and target areas. Results are applicable to the design of rain-gage networks.

2405. Weather Modification Program for the Future, by Howard T. Orville. (IR) The present status of weather modifica-

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tion is described and improvements are suggested. Recommendations for research, which would implement those of the Advisory Committee on Weather Control, are included.

2406. The Santa Barbara Project, by Robin R. Reynolds. (IR) California has set up a gigantic project called the California Water Plan, designed to guarantee adequate water for all uses for many years to come. To determine possible effects of weather modification on this plan, a large experiment was set up involving carefully controlled cloud-seeding and evaluation of results.

2407. Russian Water Supply and Treatment Practices, by V. J. Calise and W. A. Homer. (SA) Russia has many lakes, rivers, and streams and, generally, has an abundant water supply. This paper reports on a survey of facilities in Russia and Eastern Europe with emphasis on municipal treatment practices and supplies. Technical literature and reports of visitors to Russia provided the main sources of information.

2408. Diffusion in a Sectionally Homogeneous Estuary, by Richard Kent. (SA) Turbulent diffusion in a well-mixed tidal estuary is considered. A practicable theory is presented from which quantitative predictions of mean pollutant-concentration distributions may be obtained for an estuary characterized by a steady-state salinity and velocity fields which are considered to vary only on the axial direction.

2409. Physical Characteristics of Drainage Basins, by Bernard L. Golding and Dana E. Low. (HY) Significant physical characteristics of drainage-basins are reviewed and defined in terms of recent usage. A standard procedure for plotting the area-distance curves and area-elevation curves is suggested. A new method for computing various important physical characteristics utilizing the standard area-distance curves, and the modified area-elevation curves is included.

2410. Italian Arch Dam and Model Confirmation, by Guido Oberti. (ST) This paper deals with the interdependence of art, experience, and science in the design of large dams. The use of improved analytical methods and large-scale model tests in determining the static behavior and stability of dams is presented, and the use of models in the preliminary design stage is described. The statical characteristics of the principal arched dams in Italy are outlined, and the results of model tests of these dams are given.

2411. Fundamental Considerations in High-Rate Digestion, by Clair N. Sawyer and Jay S. Grumbling. (SA) A comparison of the result obtained in high-rate digestion, using shortened digestion times versus sludge concentration is presented. The importance of fixed solids loadings in relation to mixing problems is described. Concepts of unimolecular and first order reaction kinetics are developed for anaerobic digestion.

2412. Roadbeds on Highways and Airport Runways, by Ira B. Mullis. (HW) The paper is intended as a guide to the rational design and construction of roadbeds for highways and airport runways. The effect of pore space, water content and cohesion of the constituent particles of the roadbed govern its strength. Other properties are secondary ones.

2413. Transmission of Waves Past a Rigid Vertical Thin Barrier, by Robert L. Wiegal. (WW) A theory is presented for the transmission of waves past a rigid vertical thin barrier extending from above the water surface to some distance below the surface. This theory is based on a consideration of wave power transmission. Laboratory data are presented to show that this theory is useful from the engineering standpoint, but that improvements are desirable.

2414. Hydrodynamic Wave Pressure on Breakwaters, by M. A. Gouda. (WW) This paper presents a theoretical solution to the problem of determining the hydrodynamic wave pressures on breakwaters. The pressures derived are in close agreement with those obtained by other methods based on observations and experiments, such as those by Luiggi, Sainflou, Cagli and Benedit.

2415. Development of Flow in Tank Draining, by David Burgreen. (HY) A theoretical study is made of the development of velocity with time, when a value at the end of a drain pipe is examined. The true velocity, obtained by considering the fluid inertia, is compared to the velocity obtained by the more well known method, which disregards the fluid inertia and assumes that the draining is governed only by the prevailing head.

2416. Highway Research, by the Committee on Research of the Highway Division (Progress Report). (HW) This report covers research work in the fields of (a) soil mechanics and foundations, (b) construction and maintenance, (c) structural design, (d) materials, (e) economics, (f) road tests, (g) traffic characteristics, and (h) geometric design as they apply to highway engineering.

2417. Developing Alternative Urban Transportation Systems, by William R. McConochie. (HW) Principles of urban transportation, applying to most large cities, were revealed by a comprehensive study of highway and transit needs of Metropolitan Washington. This paper, based primarily on civil engineering studies, describes costs, advantages and disadvantages of auto-dominant, all-bus, all-rail, and recommended plans for Washington, D. C.

2418. Discussion of Proceedings Paper 1899, 2146. (HW) Miles D. Catton on 1899. Charles E. Carlson on 2146.

2419. Discussion of Proceedings Paper 1976, 2171, 2173, 2175. (WW) J. B. Schijf on 1976. Jose Reis de Carvalho and Daniel Vera-Cruz, William H. Booth, Jr., Francis B. Slichter, Leland B. Jones on 2171. G. B. Fenwick on 2173. W. F. Manning, Nicholas Bilonok, Jerome M. Richolson on 2175.

2420. Canadian Section of the St. Lawrence Seaway, by Lawrence H. Burpee. (WW) This paper describes the project and summarizes many of the facts relating to the navigation features of the Canadian share of the work. Preliminary facts relating to operation are given.

2421. Design and Construction of Navy's Largest Drydock, by S. P. Zola and P. M. Boothe. (WW) This paper presents a technical description of the design and construction of the Navy's largest drydock at the Puget Sound Naval Shipyard, Bremerton, Wash. The ever increasing dimensions of naval ships, since World War II, require facilities capable of accommodating this class of vessel.

2422. Waves in Navigation Canals due to Lock Filling, by Hans-Werner Partenscky. (WW) To allow for the increase in traffic on European canals it became necessary to replace existing locks or to improve efficiency. Such work resulted in the rapid flow of canal water. This paper is concerned with the effect of this flow on structures and ships.

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